US006081785A

United States Patent [19]

Oshima et al.

[11] Patent Number: 6,081,785

[45] Date of Patent: Jun. 27, 2000

[54] **OPTICAL DISK, OPTICAL RECORDER, OPTICAL REPRODUCER, CRYTOCOMMUNICATION SYSTEM AND PROGRAM LICENSE SYSTEM**

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[73] Assignee: **Matsushita Electric Industrial Co., Ltd.**, Japan

[21] Appl. No.: **08/849,468**

[22] PCT Filed: **Oct. 8, 1996**

[86] PCT No.: **PCT/JP96/02924**

§ 371 Date: **Jun. 9, 1997**

§ 102(e) Date: **Jun. 9, 1997**

[87] PCT Pub. No.: **WO97/14144**

PCT Pub. Date: **Apr. 17, 1997**

[30] **Foreign Application Priority Data**

Oct. 9, 1995	[JP]	Japan	7/261247
Jan. 23, 1996	[JP]	Japan	8/008910
Aug. 9, 1996	[JP]	Japan	8/211304

[51] **Int. Cl.**[7] **H04K 1/00**

[52] **U.S. Cl.** **705/1**; 380/201; 369/272

[58] **Field of Search** 705/1; 380/4, 201; 369/59, 58, 47, 54, 272, 275.1; 235/495

[56] **References Cited**

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5,513,169	4/1996	Fite et al.	369/272
5,761,301	6/1998	Oshimal et al.	380/4
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5,881,038	3/1999	Oshima et al.	369/59

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0 741382	6/1996	European Pat. Off.	G11B 7/00

Primary Examiner—Kevin J. Teska
Assistant Examiner—Demetra R. Smith
Attorney, Agent, or Firm—Parkhurst & Wendel, L.L.P

[57] **ABSTRACT**

The operating and other procedures of an optical disk application system of the type for which a network is used are simplified. Optical disks have auxiliary data recording areas, where different IDs for individual disks, and/or cipher keys and/or decoding keys for ciphers are recorded in advance in a factory. By using the IDs to release the soft ciphers, using the cipher keys when sending the ciphers, and using the decoding keys when receiving the ciphers, user authorization procedures are simplified.

5 Claims, 35 Drawing Sheets

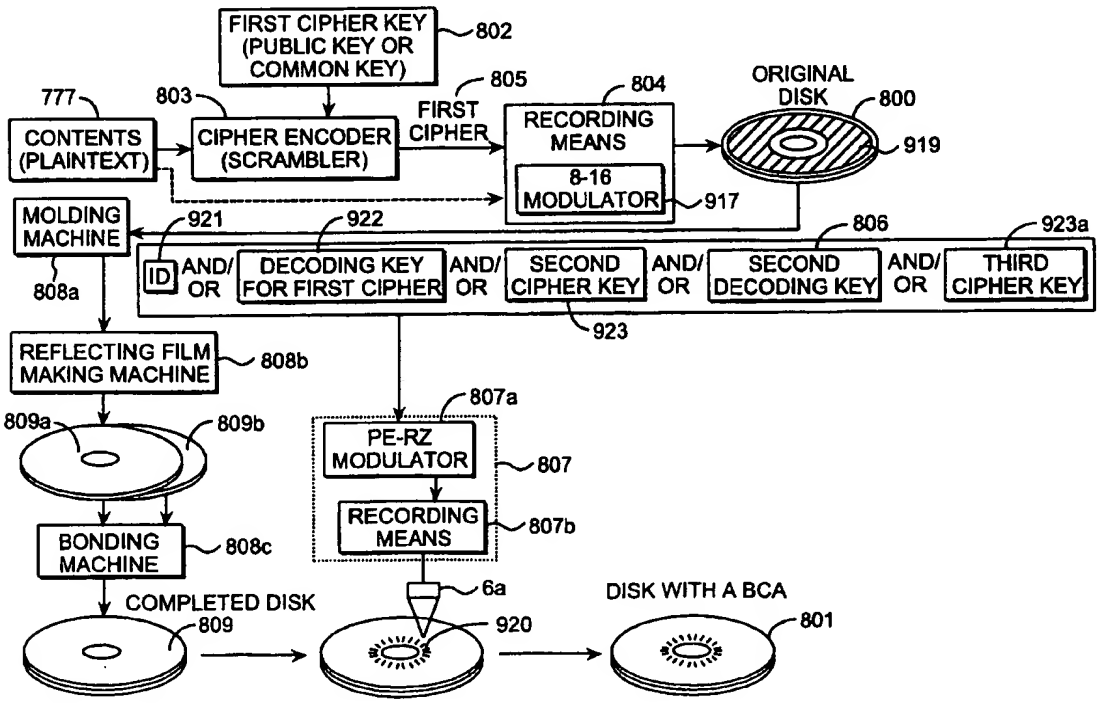
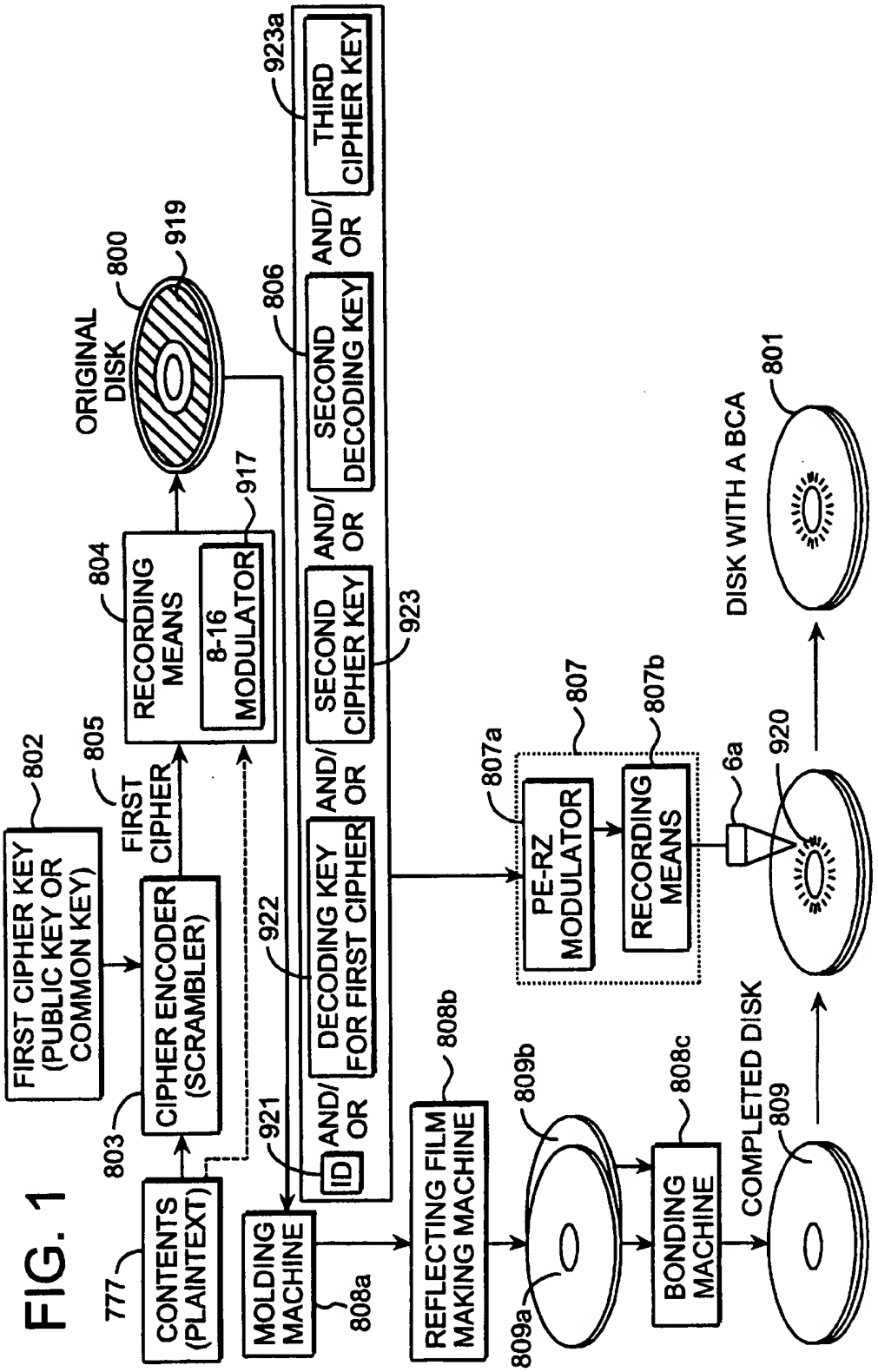


FIG. 1


777
CONTENTS (PLAINTEXT)
803
CIPHER ENCODER (SCRAMBLER)
802
FIRST CIPHER KEY (PUBLIC KEY OR COMMON KEY)
805
FIRST CIPHER
804
RECORDING MEANS
8-16 MODULATOR
917
ORIGINAL DISK
800
919
806
SECOND DECODING KEY
AND/OR
923a
THIRD CIPHER KEY
923
SECOND CIPHER KEY
AND/OR
922
DECODING KEY FOR FIRST CIPHER
AND/OR
ID
921
MOLDING MACHINE
808a
REFLECTING FILM MAKING MACHINE
808b
809a
809b
BONDING MACHINE
808c
COMPLETED DISK
809
807a
PE-RZ MODULATOR
807
RECORDING MEANS
807b
6a
920
DISK WITH A BCA
801

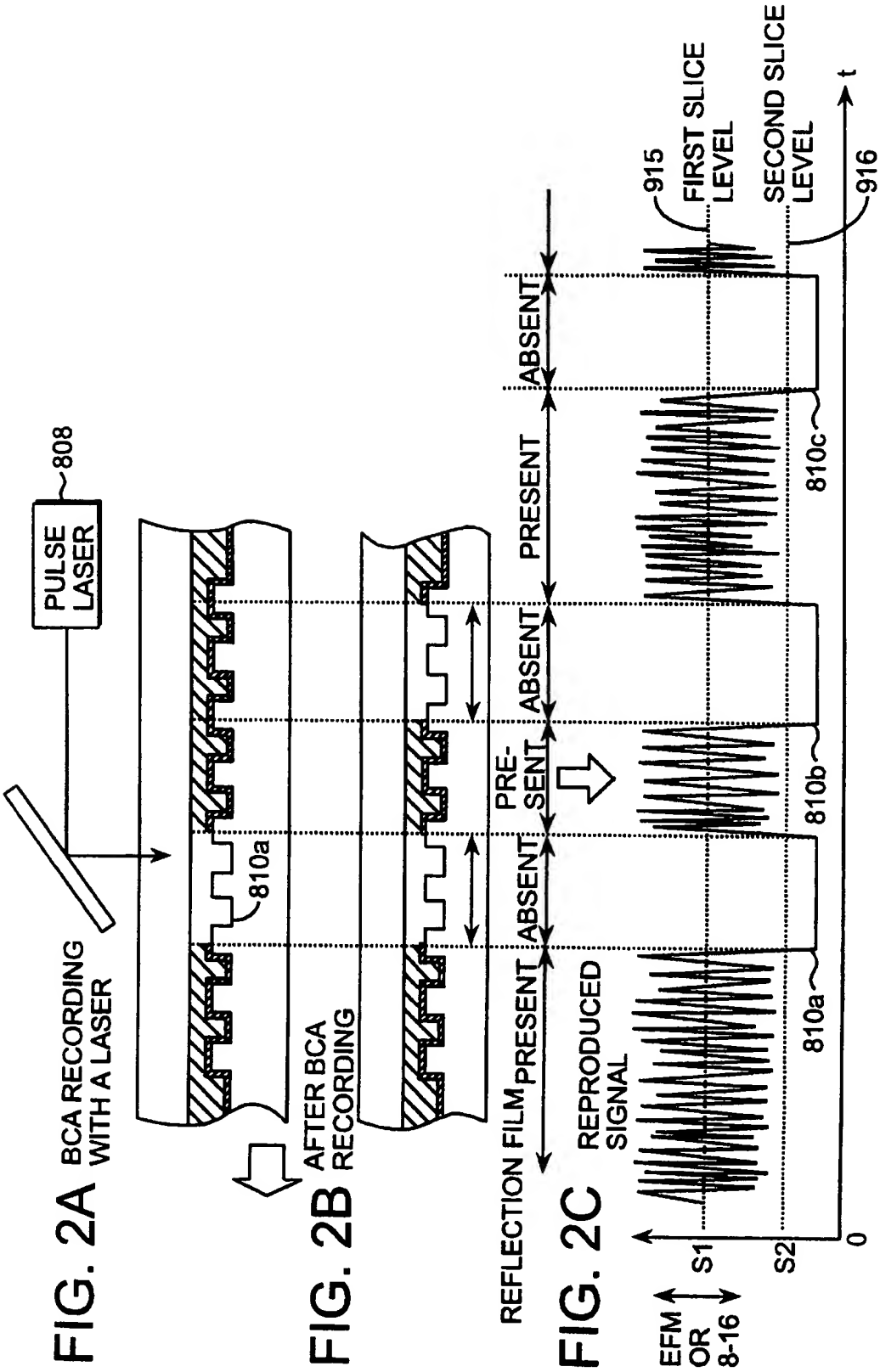
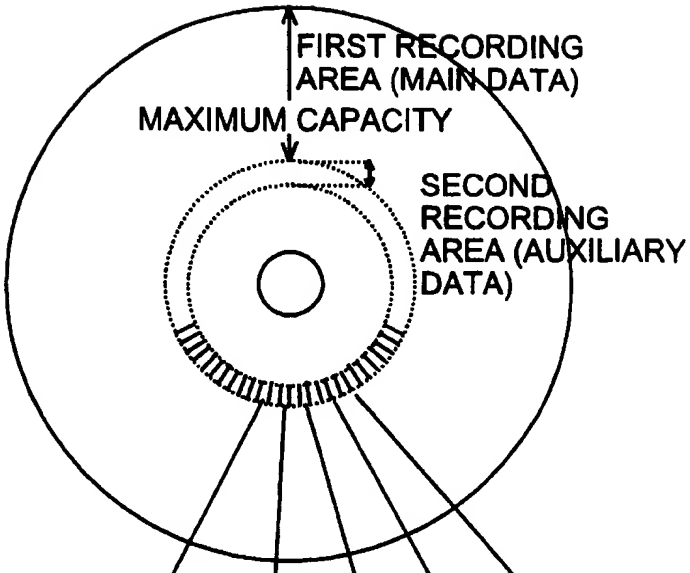


FIG. 2A

FIG. 2B

FIG. 2C

FIG. 3A
TOP PLAN



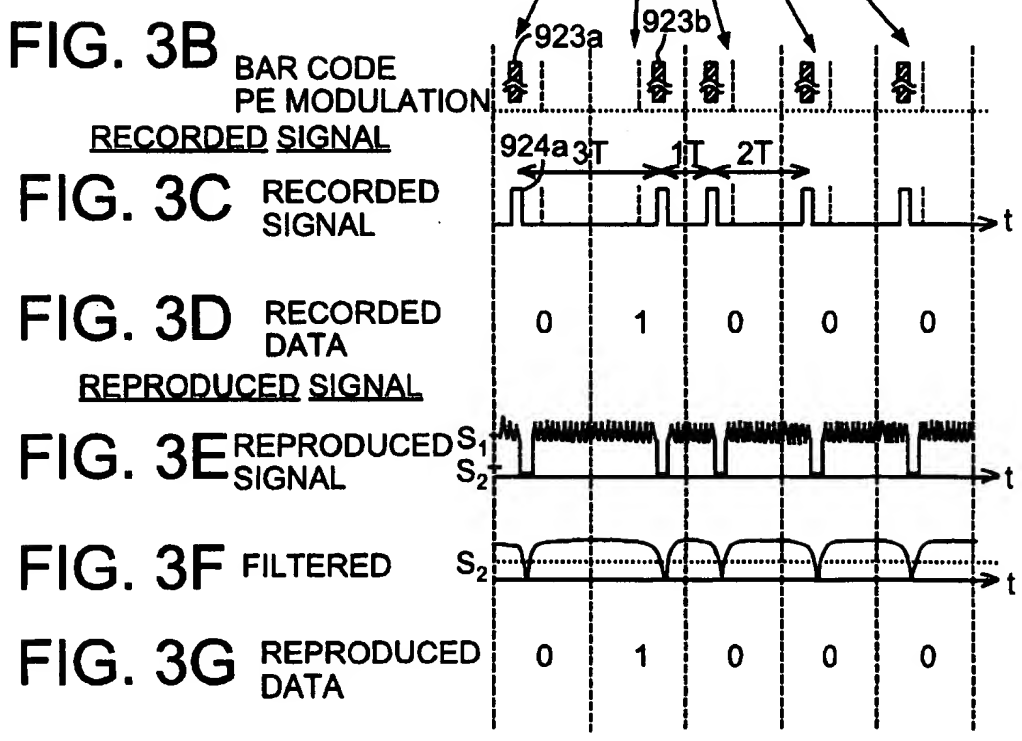


FIG. 3B BAR CODE PE MODULATION

RECORDED SIGNAL

FIG. 3C RECORDED SIGNAL

FIG. 3D RECORDED DATA

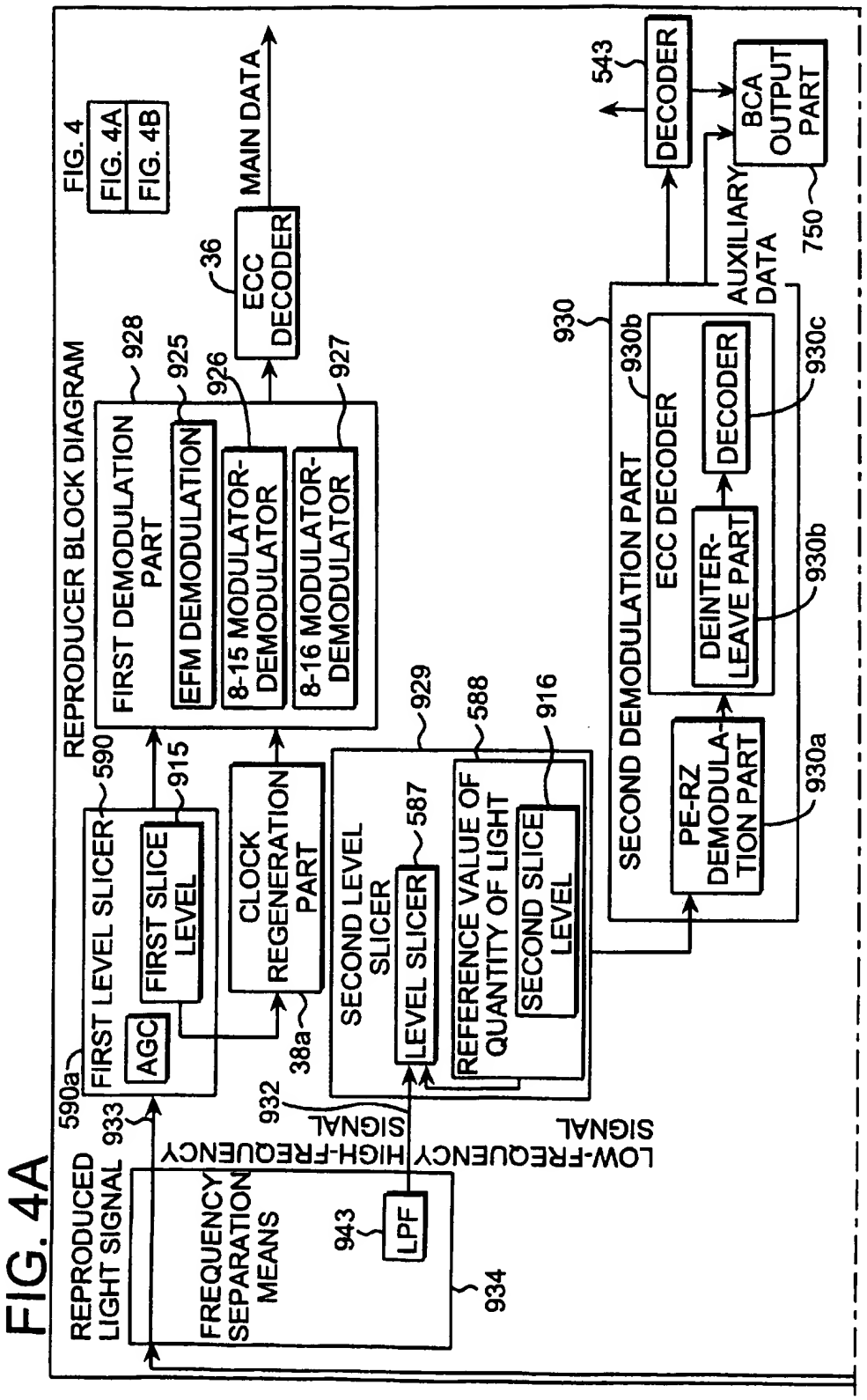
REPRODUCED SIGNAL

FIG. 3E REPRODUCED SIGNAL

FIG. 3F FILTERED

FIG. 3G REPRODUCED DATA

FIG. 4A


REPRODUCER BLOCK DIAGRAM
FIG. 4
FIG. 4A
FIG. 4B
REPRODUCED LIGHT SIGNAL
933
590a
FREQUENCY SEPARATION MEANS
943
LPF
934
HIGH-FREQUENCY SIGNAL
932
LOW-FREQUENCY SIGNAL
FIRST LEVEL SLICER
590
AGC
FIRST SLICE LEVEL
915
38a
CLOCK REGENERATION PART
SECOND LEVEL SLICER
929
LEVEL SLICER
587
REFERENCE VALUE OF QUANTITY OF LIGHT
588
SECOND SLICE LEVEL
916
FIRST DEMODULATION PART
928
EFM DEMODULATION
925
8-15 MODULATOR-DEMODULATOR
926
8-16 MODULATOR-DEMODULATOR
927
ECC DECODER
36
MAIN DATA
SECOND DEMODULATION PART
930
ECC DECODER
930b
DEINTER-LEAVE PART
930b
PE-RZ DEMODULATION PART
930a
DECODER
930c
AUXILIARY DATA
750
DECODER
543
BCA OUTPUT PART

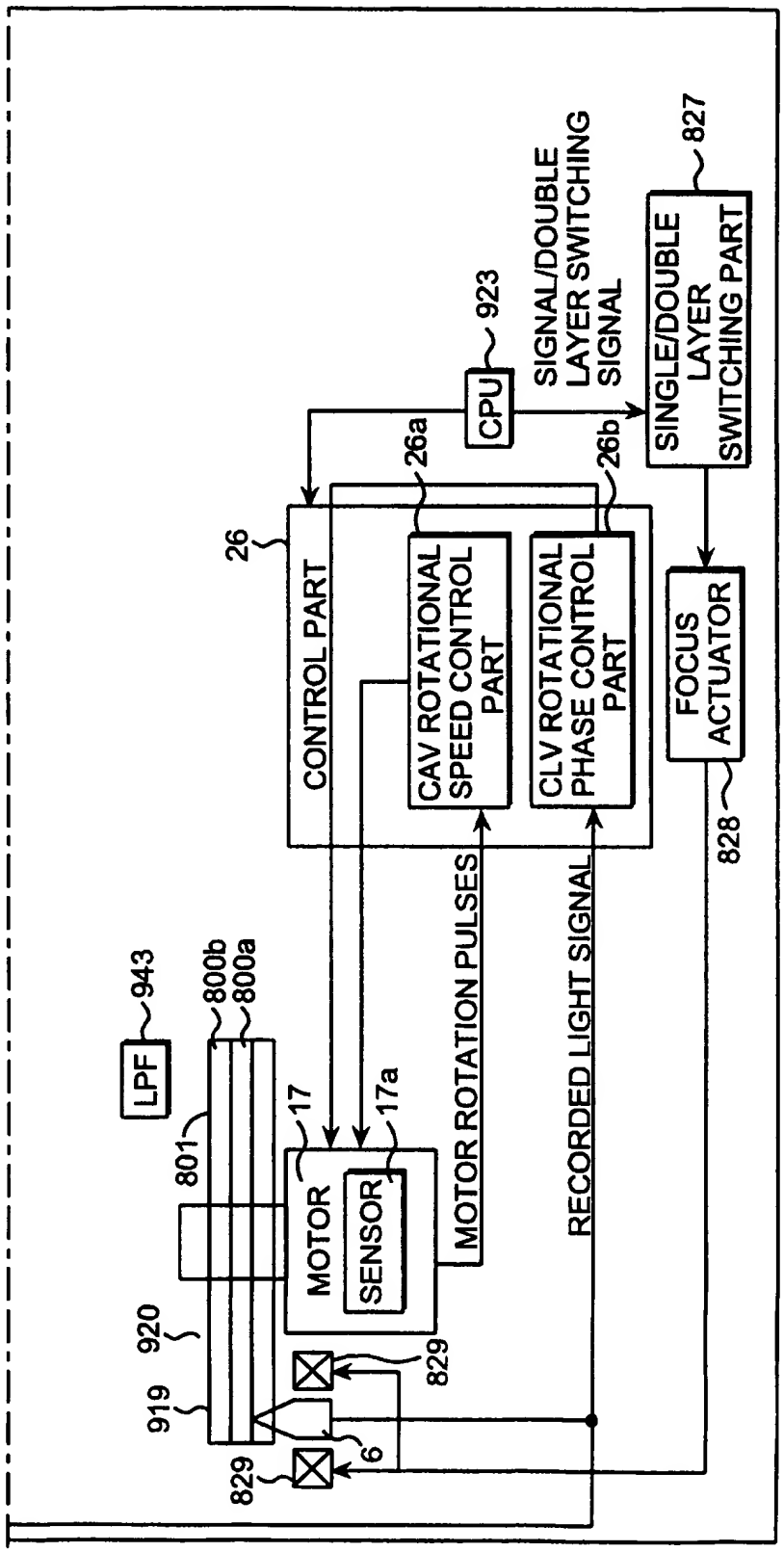
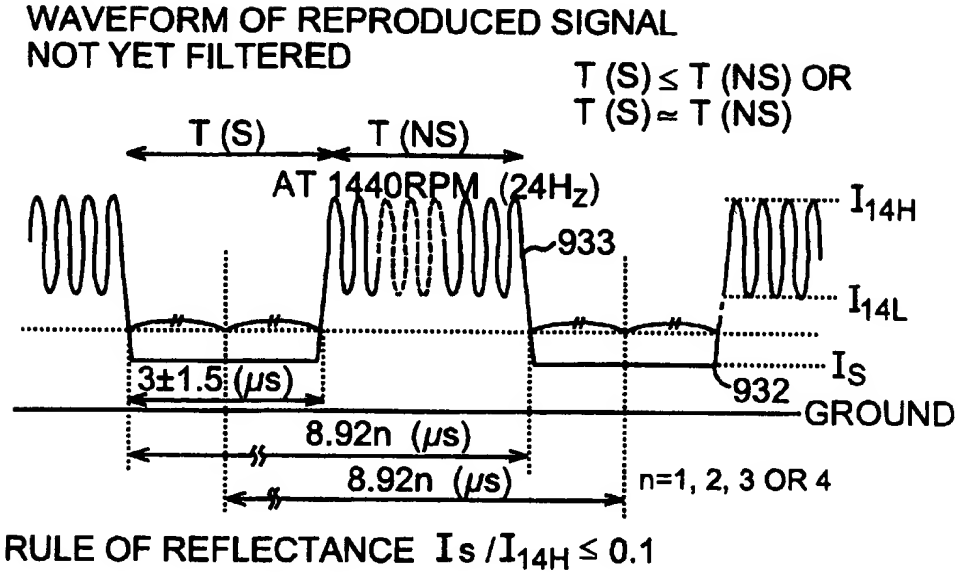

CPU
923
SIGNAL/DOUBLE LAYER SWITCHING SIGNAL
SINGLE/DOUBLE LAYER SWITCHING PART
827
26a
26b
26
CONTROL PART
CAV ROTATIONAL SPEED CONTROL PART
CLV ROTATIONAL PHASE CONTROL PART
FOCUS ACTUATOR
828
MOTOR ROTATION PULSES
RECORDED LIGHT SIGNAL
LPF
943
800b
800a
801
17
17a
MOTOR
SENSOR
920
919
829
6

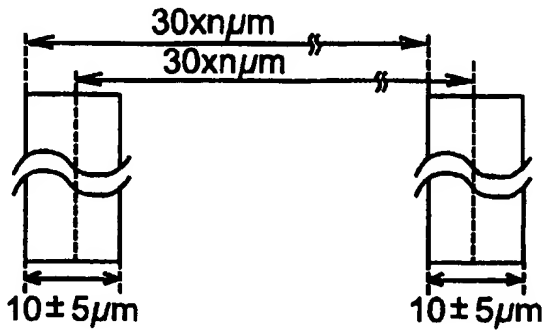
FIG. 4B

FIG. 5A



RULE OF REFLECTANCE $Is / I_{14H} \leq 0.1$

FIG. 5B SLIT DIMENSION ACCURACY (PRECISION)
(AT r=22.2mm)



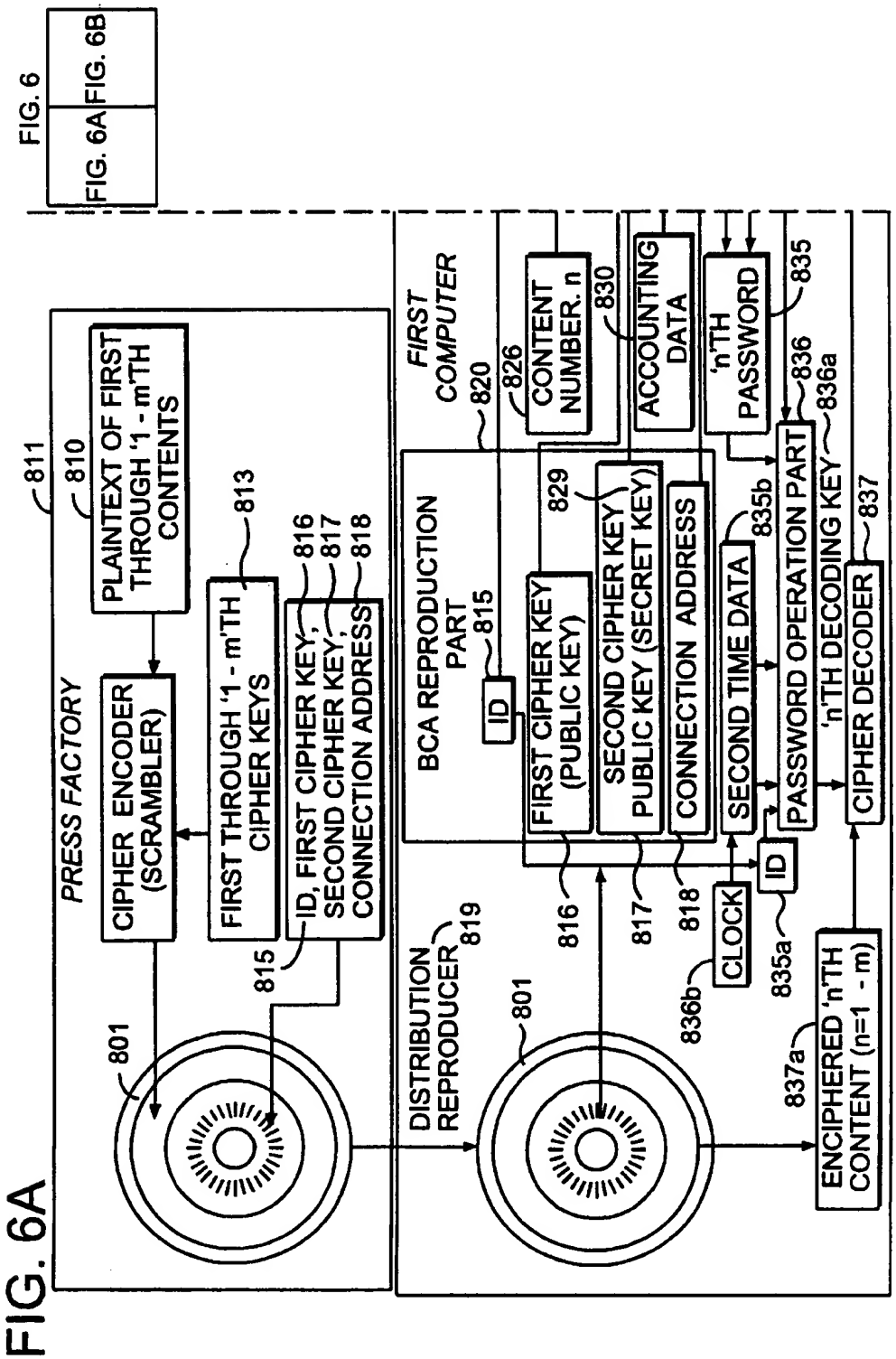


FIG. 6
FIG. 6A
FIG. 6B
PRESS FACTORY
811
PLAINTEXT OF FIRST THROUGH '1 - m'TH CONTENTS
810
CIPHER ENCODER (SCRAMBLER)
FIRST THROUGH '1 - m'TH CIPHER KEYS
813
ID, FIRST CIPHER KEY, SECOND CIPHER KEY, CONNECTION ADDRESS
816
817
818
815
801
DISTRIBUTION REPRODUCER
819
FIRST COMPUTER
820
BCA REPRODUCTION PART
815
ID
FIRST CIPHER KEY (PUBLIC KEY)
829
SECOND CIPHER KEY PUBLIC KEY (SECRET KEY)
CONNECTION ADDRESS
CONTENT NUMBER. n
826
ACCOUNTING DATA
830
'n'TH PASSWORD
835
SECOND TIME DATA
835b
PASSWORD OPERATION PART
836
836a
'n'TH DECODING KEY
837
CIPHER DECODER
CLOCK
836b
ID
835a
ENCIPHERED 'n'TH CONTENT (n=1 - m)
837a
801
816
817
818

FIG. 6A

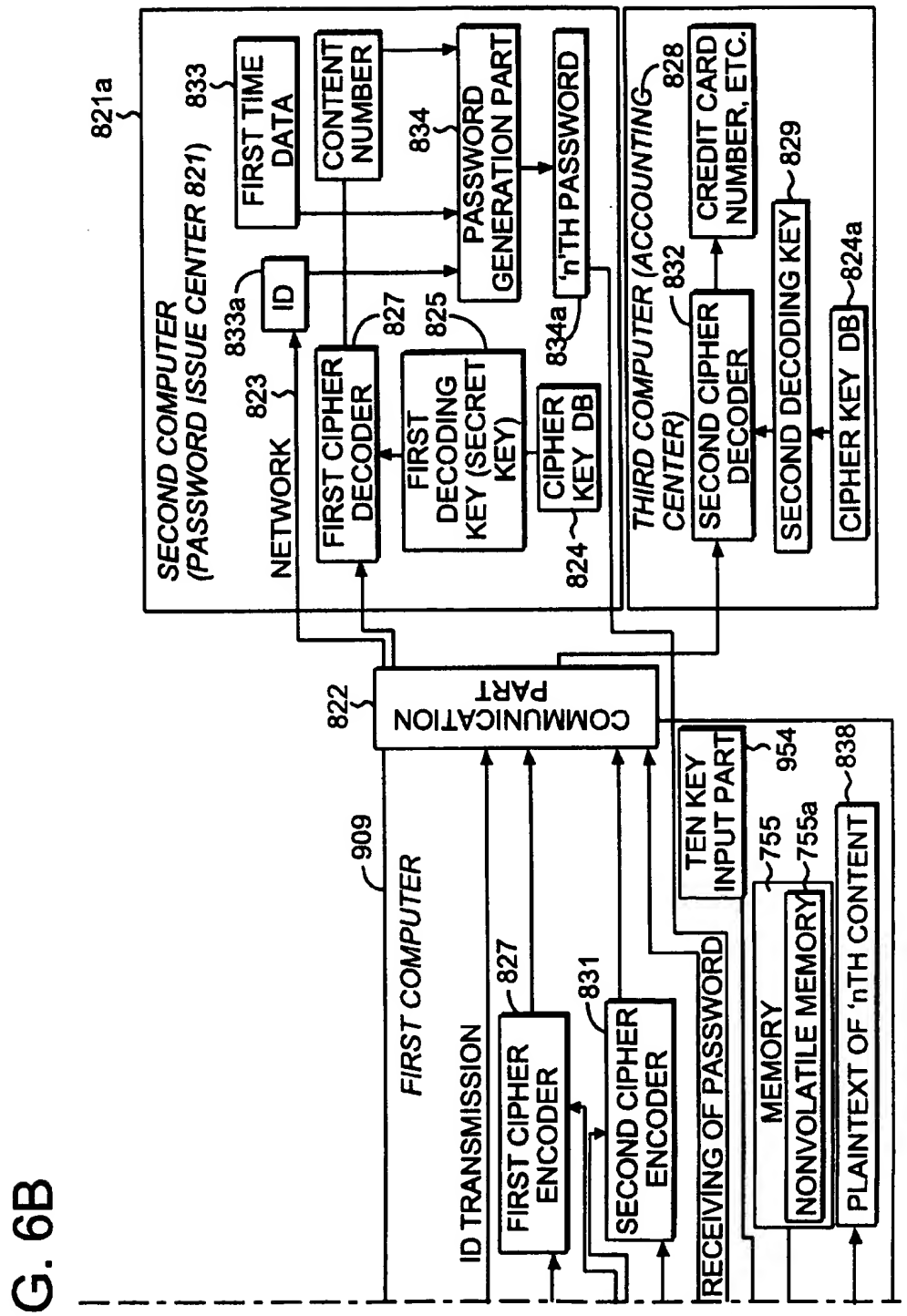
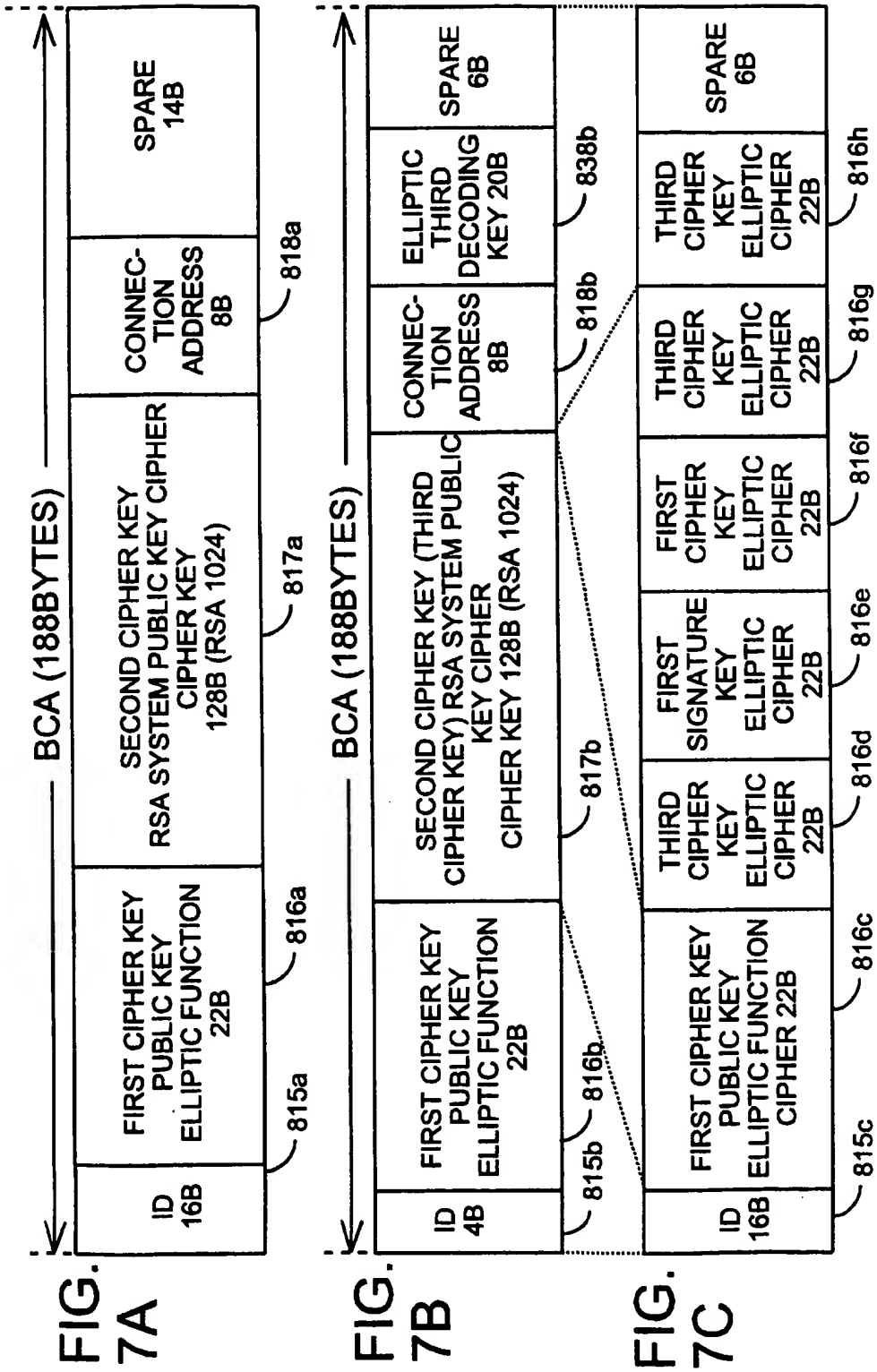

821a
SECOND COMPUTER (PASSWORD ISSUE CENTER 821)
833
FIRST TIME DATA
CONTENT NUMBER
834
PASSWORD GENERATION PART
'n'TH PASSWORD
833a
ID
823
NETWORK
FIRST CIPHER DECODER
827
825
FIRST DECODING KEY (SECRET KEY)
CIPHER KEY DB
824
834a
THIRD COMPUTER (ACCOUNTING CENTER)
828
CREDIT CARD NUMBER, ETC.
832
SECOND CIPHER DECODER
SECOND DECODING KEY
829
CIPHER KEY DB
824a
822
COMMUNICATION PART
909
FIRST COMPUTER
ID TRANSMISSION
827
FIRST CIPHER ENCODER
831
SECOND CIPHER ENCODER
RECEIVING OF PASSWORD
TEN KEY INPUT PART
954
755
MEMORY
755a
NONVOLATILE MEMORY
838
PLAINTEXT OF 'nTH CONTENT

FIG. 6B


BCA (188BYTES)
ID 16B
FIRST CIPHER KEY PUBLIC KEY ELLIPTIC FUNCTION 22B
SECOND CIPHER KEY RSA SYSTEM PUBLIC KEY CIPHER CIPHER KEY 128B (RSA 1024)
CONNEC-TION ADDRESS 8B
SPARE 14B
815a
816a
817a
818a
FIG. 7A
BCA (188BYTES)
ID 4B
FIRST CIPHER KEY PUBLIC KEY ELLIPTIC FUNCTION 22B
SECOND CIPHER KEY (THIRD CIPHER KEY) RSA SYSTEM PUBLIC KEY CIPHER CIPHER KEY 128B (RSA 1024)
CONNEC-TION ADDRESS 8B
ELLIPTIC THIRD DECODING KEY 20B
SPARE 6B
815b
816b
817b
818b
838b
FIG. 7B
ID 16B
FIRST CIPHER KEY PUBLIC KEY ELLIPTIC FUNCTION CIPHER 22B
THIRD CIPHER KEY ELLIPTIC CIPHER 22B
FIRST SIGNATURE KEY ELLIPTIC CIPHER 22B
FIRST CIPHER KEY ELLIPTIC CIPHER 22B
THIRD CIPHER KEY ELLIPTIC CIPHER 22B
SPARE 6B
815c
816c
816d
816e
816f
816g
816h
FIG. 7C

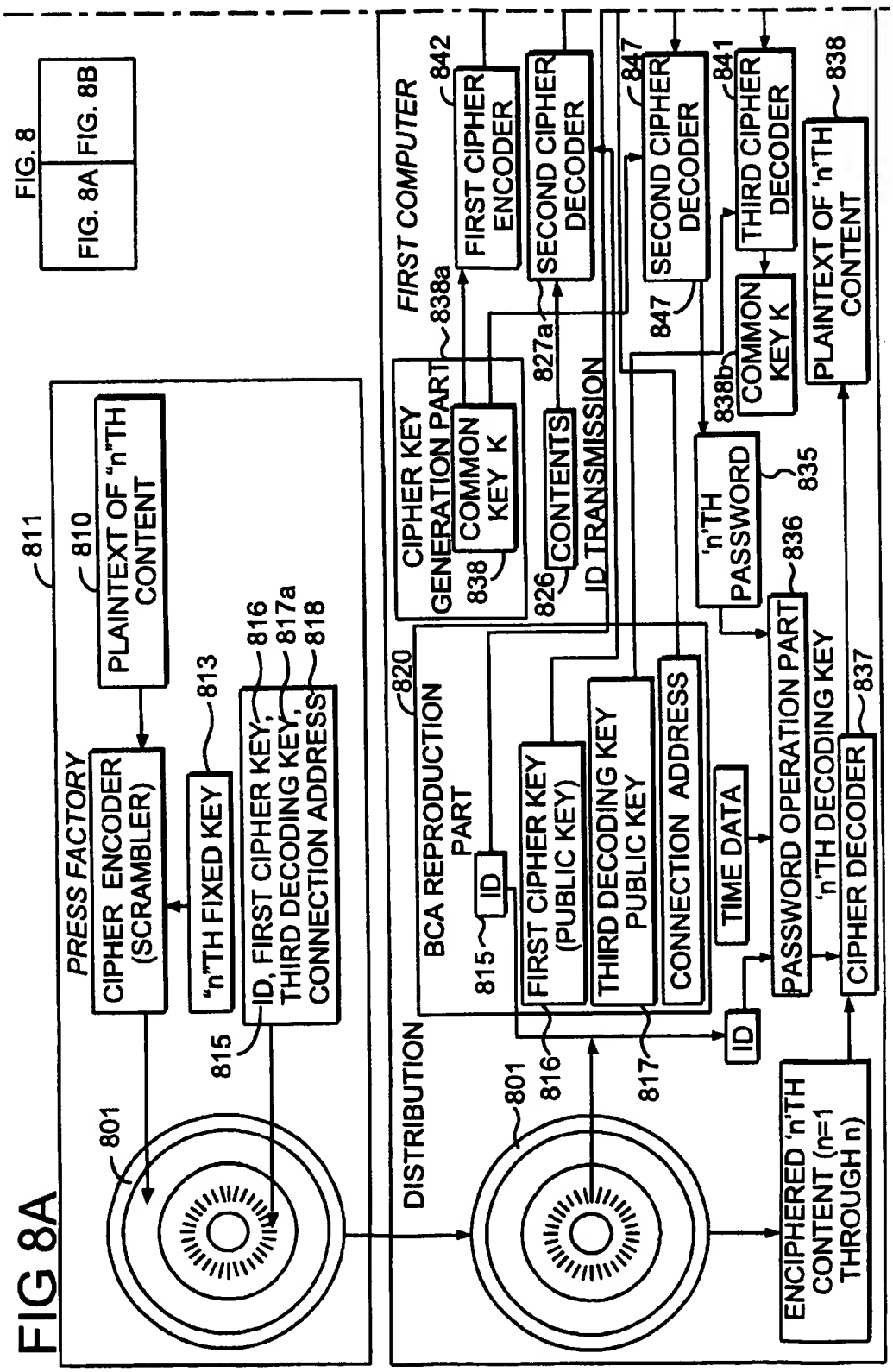


FIG. 8
FIG. 8A
FIG. 8B
PRESS FACTORY
811
PLAINTEXT OF "n"TH CONTENT
810
CIPHER ENCODER (SCRAMBLER)
"n"TH FIXED KEY
813
ID, FIRST CIPHER KEY, THIRD DECODING KEY, CONNECTION ADDRESS
816
817a
818
815
801
DISTRIBUTION
FIRST COMPUTER
842
FIRST CIPHER ENCODER
SECOND CIPHER DECODER
847
SECOND CIPHER DECODER
841
THIRD CIPHER DECODER
838
PLAINTEXT OF 'n'TH CONTENT
838a
CIPHER KEY GENERATION PART
COMMON KEY K
838
826
CONTENTS
ID TRANSMISSION
827a
847
838b
COMMON KEY K
'n'TH PASSWORD
835
836
820
BCA REPRODUCTION PART
ID
815
FIRST CIPHER KEY (PUBLIC KEY)
THIRD DECODING KEY PUBLIC KEY
CONNECTION ADDRESS
TIME DATA
PASSWORD OPERATION PART
'n'TH DECODING KEY
837
CIPHER DECODER
ID
801
816
817
ENCIPHERED 'n'TH CONTENT (n=1 THROUGH n)
FIG 8A

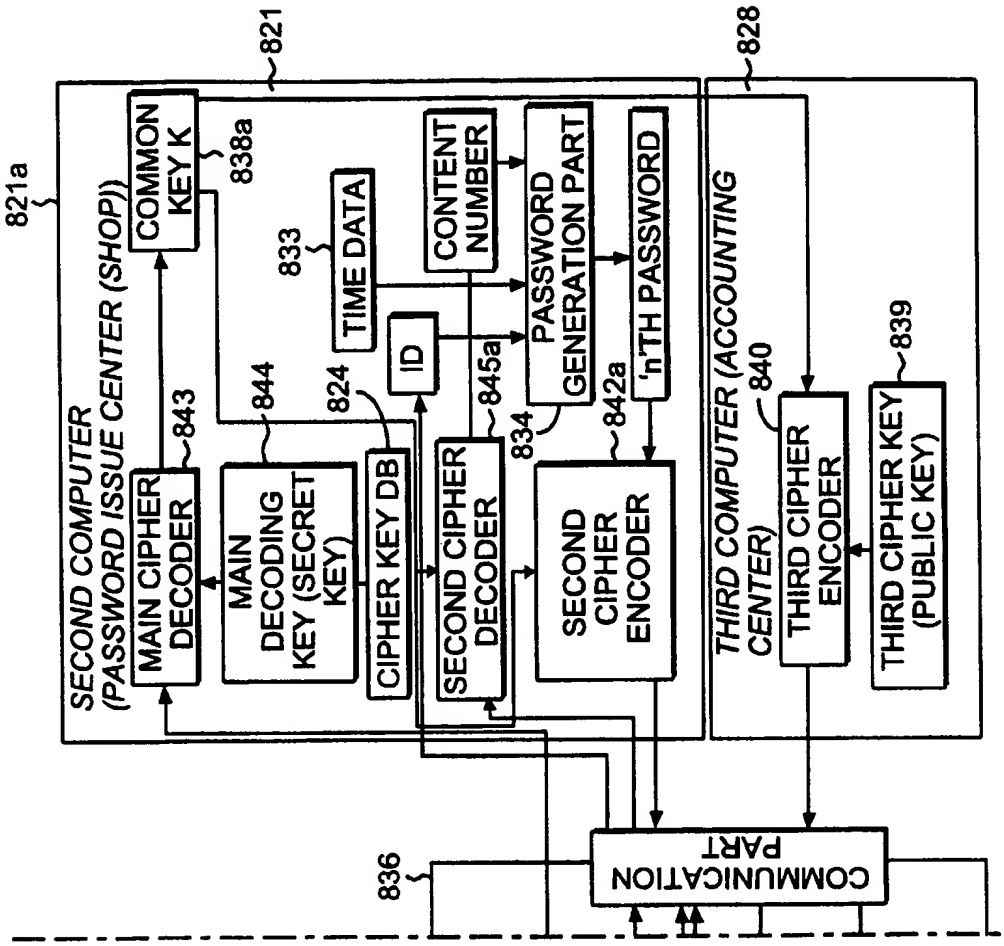

821
828
821a
SECOND COMPUTER (PASSWORD ISSUE CENTER (SHOP))
COMMON KEY K
838a
833
TIME DATA
CONTENT NUMBER
PASSWORD GENERATION PART
'n'TH PASSWORD
ID
845a
834
842a
824
844
843
MAIN CIPHER DECODER
MAIN DECODING KEY (SECRET KEY)
CIPHER KEY DB
SECOND CIPHER DECODER
SECOND CIPHER ENCODER
THIRD COMPUTER (ACCOUNTING CENTER)
840
THIRD CIPHER ENCODER
839
THIRD CIPHER KEY (PUBLIC KEY)
836
COMMUNICATION PART

FIG 8B

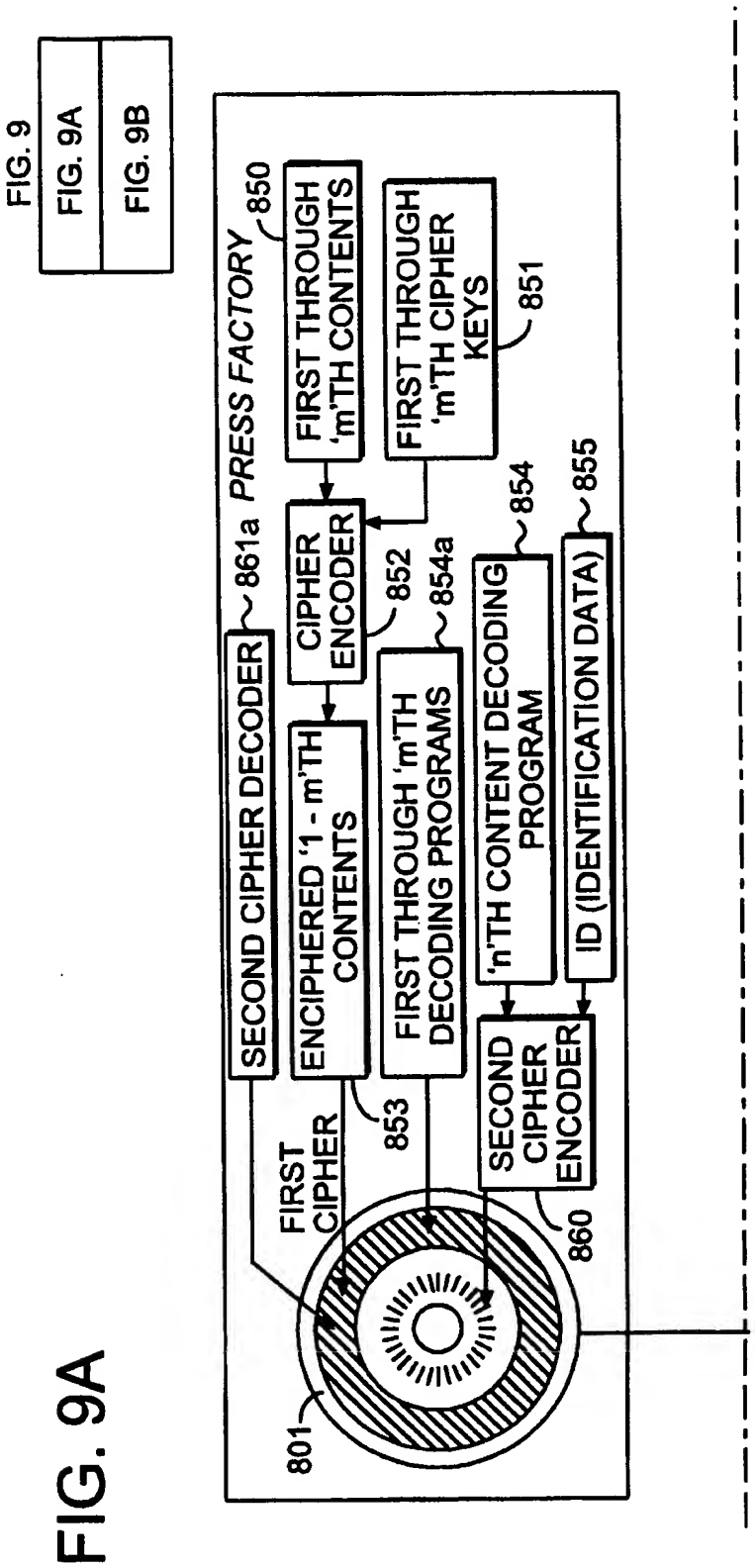


FIG. 9
FIG. 9A
FIG. 9B
PRESS FACTORY
850
FIRST THROUGH 'm'TH CONTENTS
FIRST THROUGH 'm'TH CIPHER KEYS
851
CIPHER ENCODER
852
SECOND CIPHER DECODER
861a
ENCIPHERED '1 - m'TH CONTENTS
853
FIRST THROUGH 'm'TH DECODING PROGRAMS
854a
'n'TH CONTENT DECODING PROGRAM
854
ID (IDENTIFICATION DATA)
855
SECOND CIPHER ENCODER
860
FIRST CIPHER
801

FIG. 9A

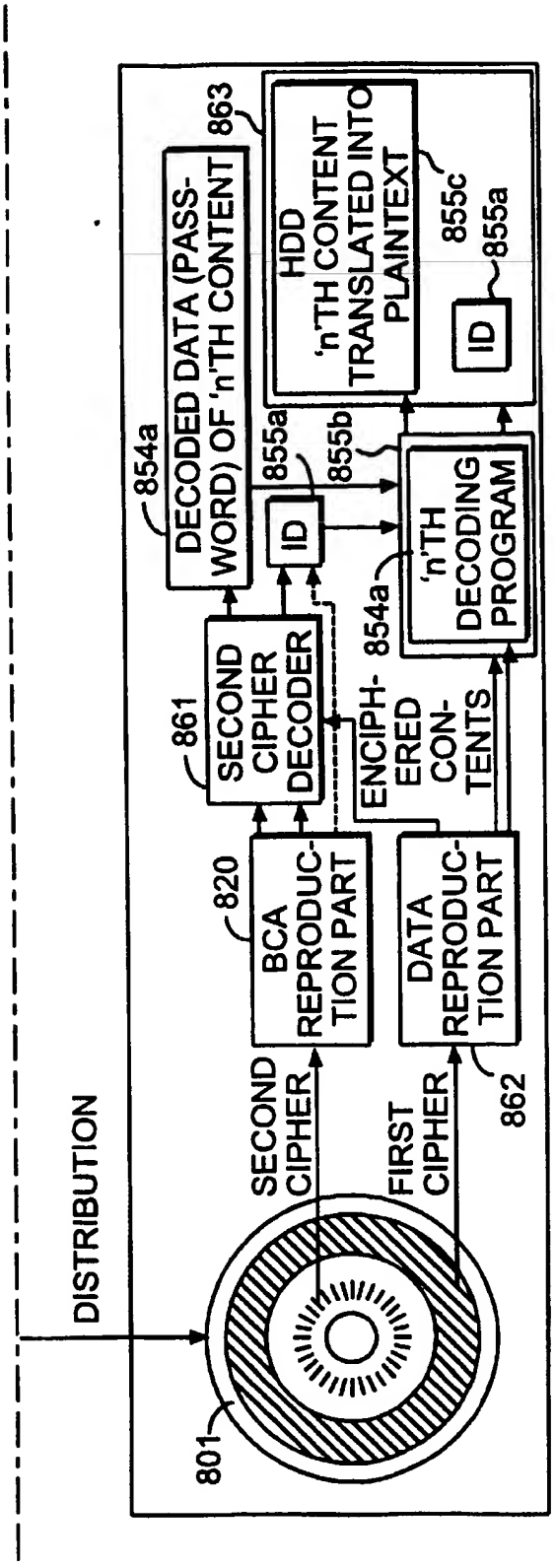

DISTRIBUTION
801
SECOND CIPHER
FIRST CIPHER
820
BCA REPRODUC-TION PART
DATA REPRODUC-TION PART
862
861
SECOND CIPHER DECODER
ENCIPH-ERED CON-TENTS
854a
'n'TH DECODING PROGRAM
854a
DECODED DATA (PASS-WORD) OF 'n'TH CONTENT
863
855a
ID
855b
HDD 'n'TH CONTENT TRANSLATED INTO PLAINTEXT
855c
855a
ID

FIG. 9B

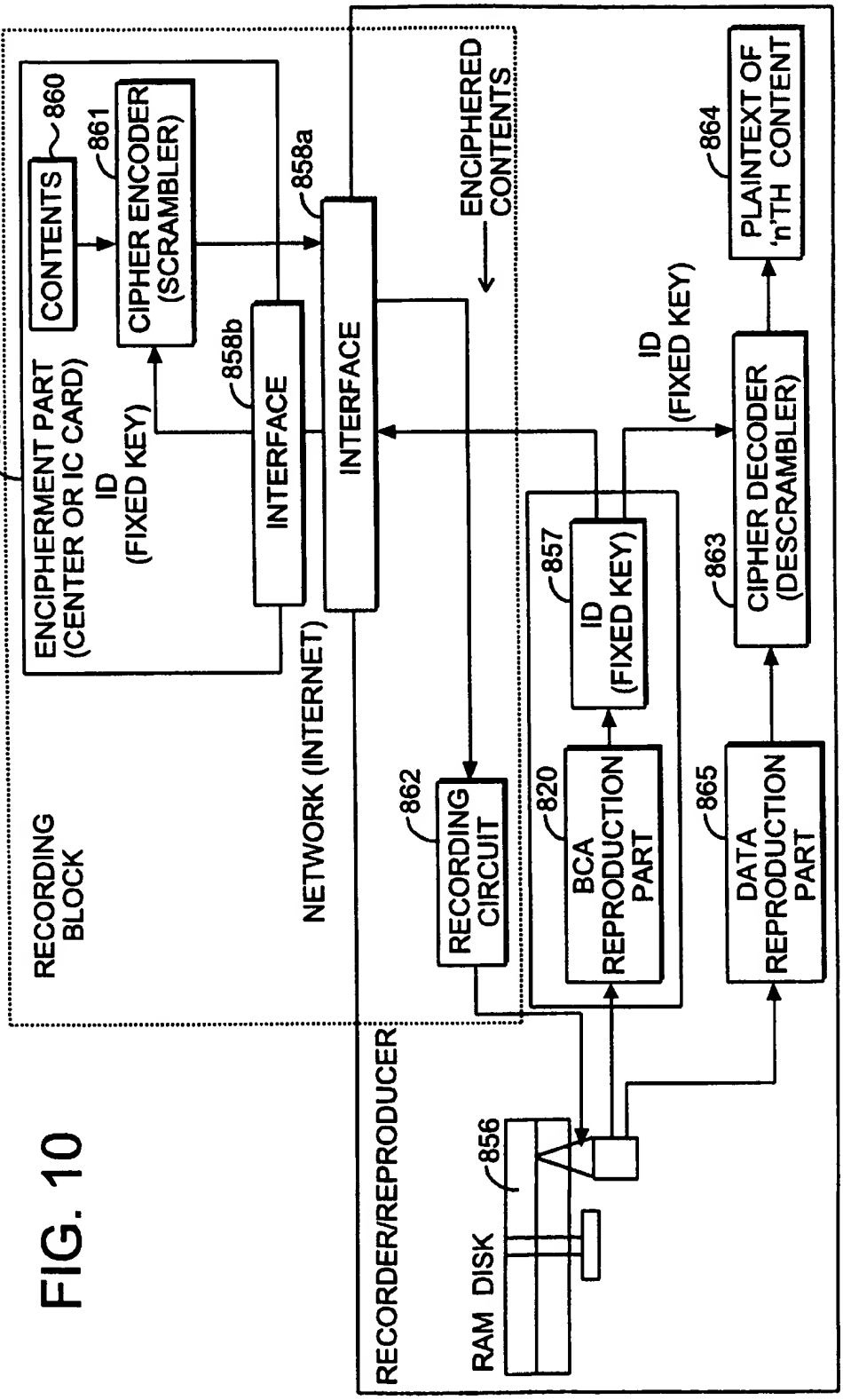

RECORDER/REPRODUCER
RECORDING BLOCK
ENCIPHERMENT PART (CENTER OR IC CARD)
859
ID (FIXED KEY)
CONTENTS
860
CIPHER ENCODER (SCRAMBLER)
861
858b
INTERFACE
858a
INTERFACE
NETWORK (INTERNET)
ENCIPHERED CONTENTS
862
RECORDING CIRCUIT
820
BCA REPRODUCTION PART
857
ID (FIXED KEY)
ID (FIXED KEY)
863
CIPHER DECODER (DESCRAMBLER)
865
DATA REPRODUCTION PART
864
PLAINTEXT OF 'n'TH CONTENT
856
RAM DISK

FIG. 10

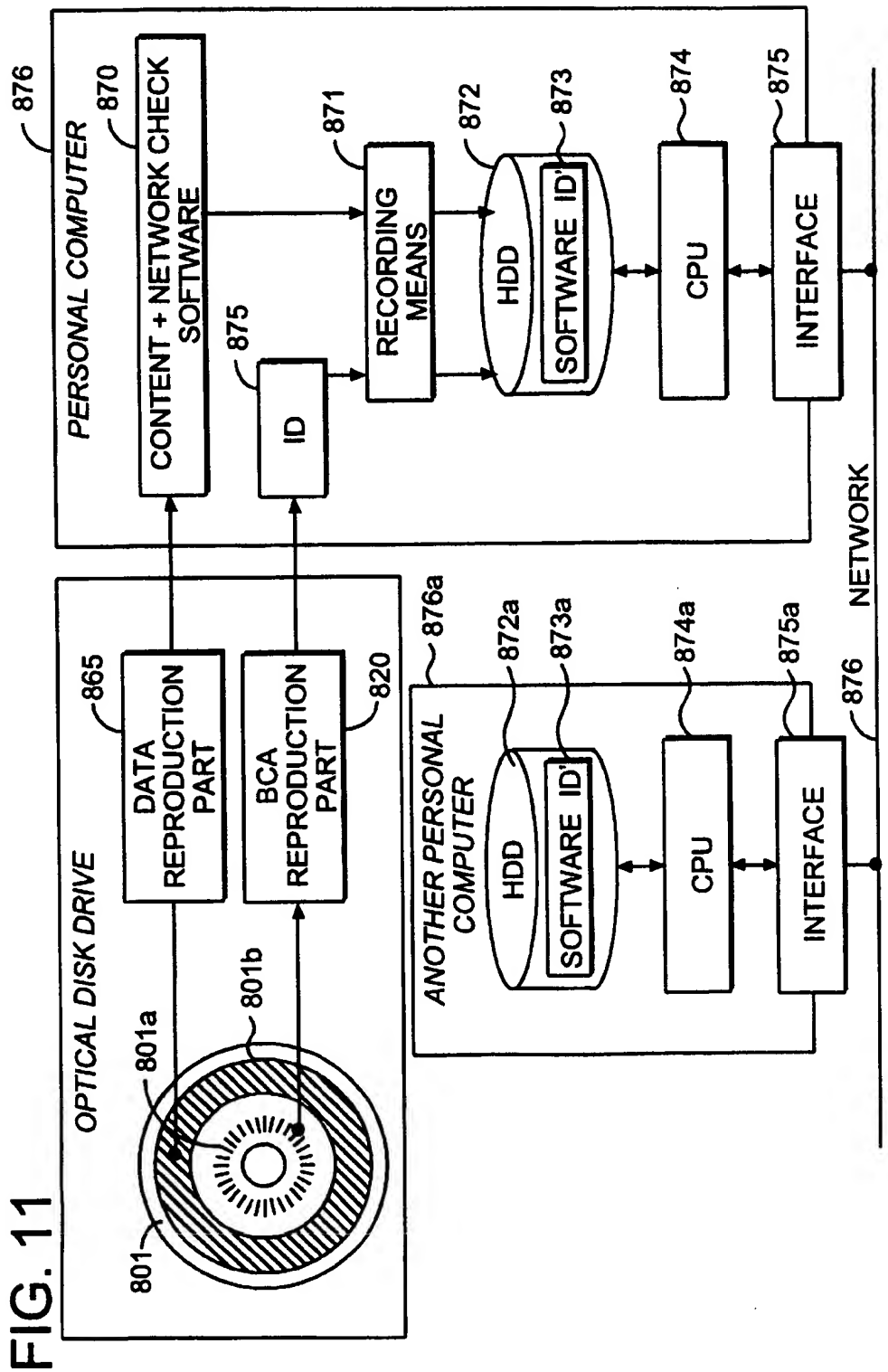
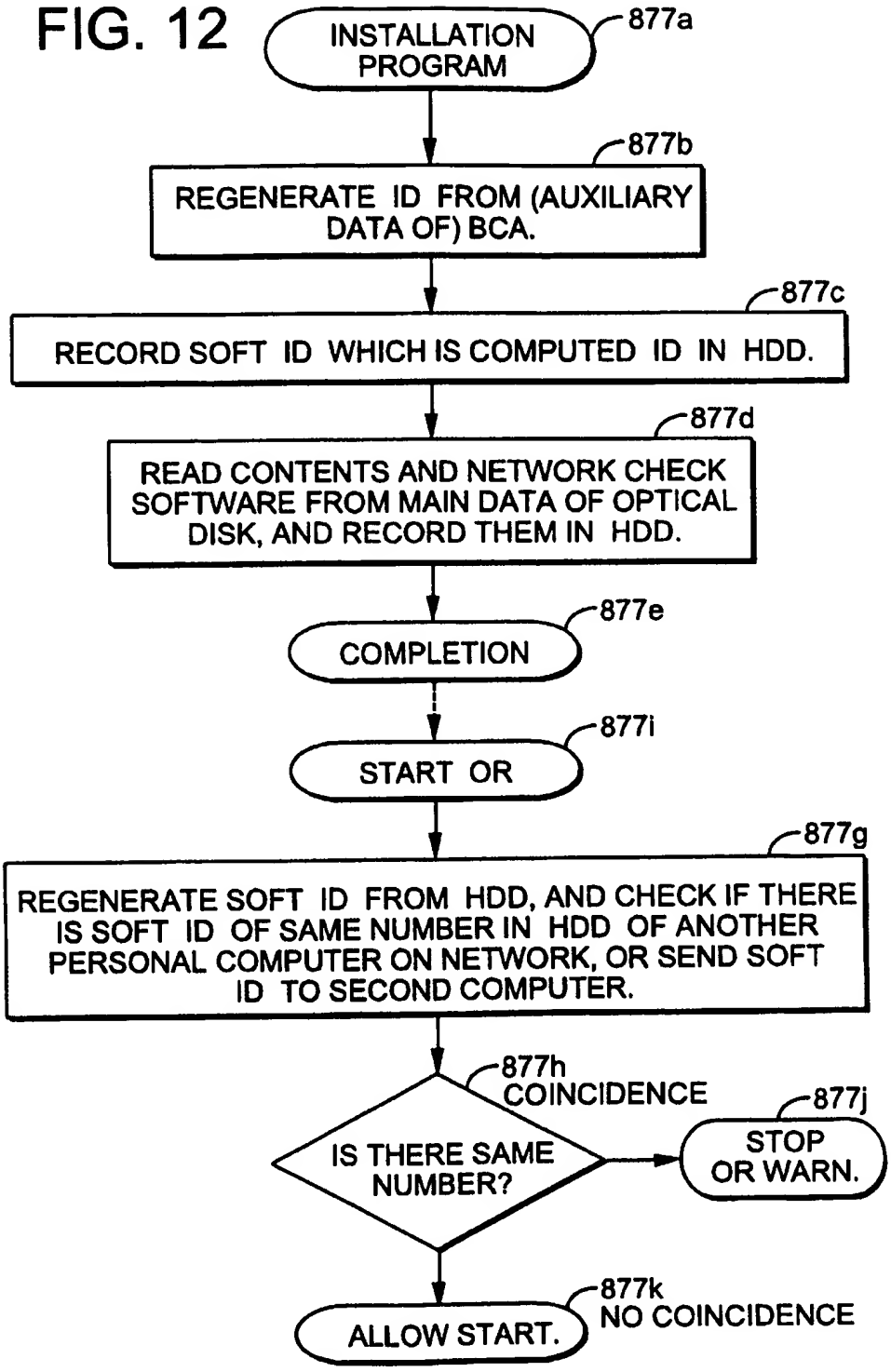
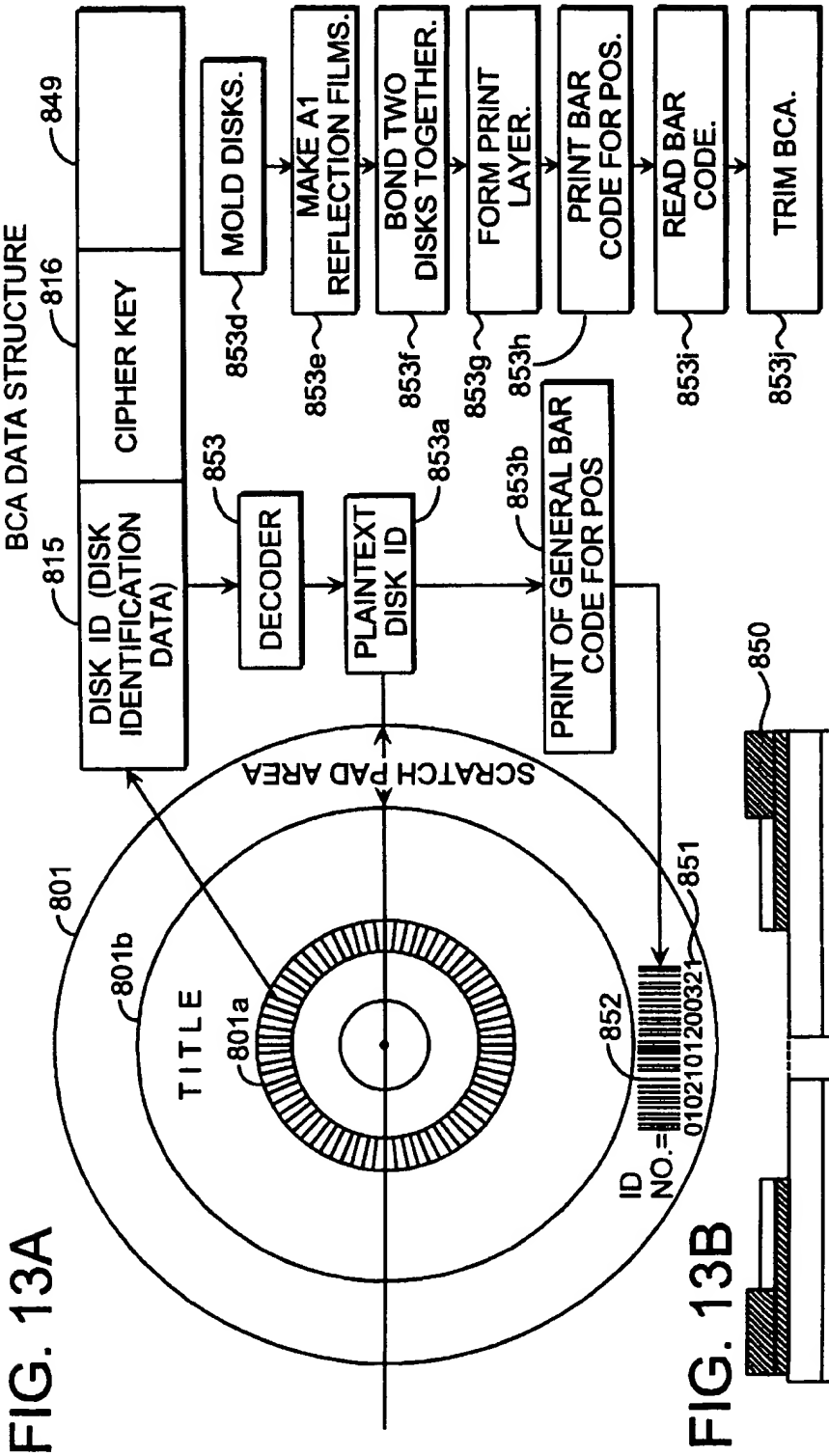

876
PERSONAL COMPUTER
870
CONTENT + NETWORK CHECK SOFTWARE
871
RECORDING MEANS
872
HDD
873
SOFTWARE ID
874
CPU
875
INTERFACE
875
ID
NETWORK
876a
872a
873a
874a
875a
876
ANOTHER PERSONAL COMPUTER
HDD
SOFTWARE ID
CPU
INTERFACE
OPTICAL DISK DRIVE
865
DATA REPRODUCTION PART
820
BCA REPRODUCTION PART
801a
801b
801

FIG. 11

FIG. 12


INSTALLATION PROGRAM
877a
877b
REGENERATE ID FROM (AUXILIARY DATA OF) BCA.
877c
RECORD SOFT ID WHICH IS COMPUTED ID IN HDD.
877d
READ CONTENTS AND NETWORK CHECK SOFTWARE FROM MAIN DATA OF OPTICAL DISK, AND RECORD THEM IN HDD.
877e
COMPLETION
877i
START OR
877g
REGENERATE SOFT ID FROM HDD, AND CHECK IF THERE IS SOFT ID OF SAME NUMBER IN HDD OF ANOTHER PERSONAL COMPUTER ON NETWORK, OR SEND SOFT ID TO SECOND COMPUTER.
877h
COINCIDENCE
IS THERE SAME NUMBER?
877j
STOP OR WARN.
877k
NO COINCIDENCE
ALLOW START.


BCA DATA STRUCTURE
849
816
CIPHER KEY
815
DISK ID (DISK IDENTIFICATION DATA)
853
DECODER
853a
PLAINTEXT DISK ID
853b
PRINT OF GENERAL BAR CODE FOR POS
MOLD DISKS.
853d
MAKE A1 REFLECTION FILMS.
853e
BOND TWO DISKS TOGETHER.
853f
FORM PRINT LAYER.
853g
PRINT BAR CODE FOR POS.
853h
READ BAR CODE.
853i
TRIM BCA.
853j
FIG. 13C
SCRATCH PAD AREA
801
801b
TITLE
801a
852
851
ID NO.=
0102101200321
FIG. 13A
850
FIG. 13B

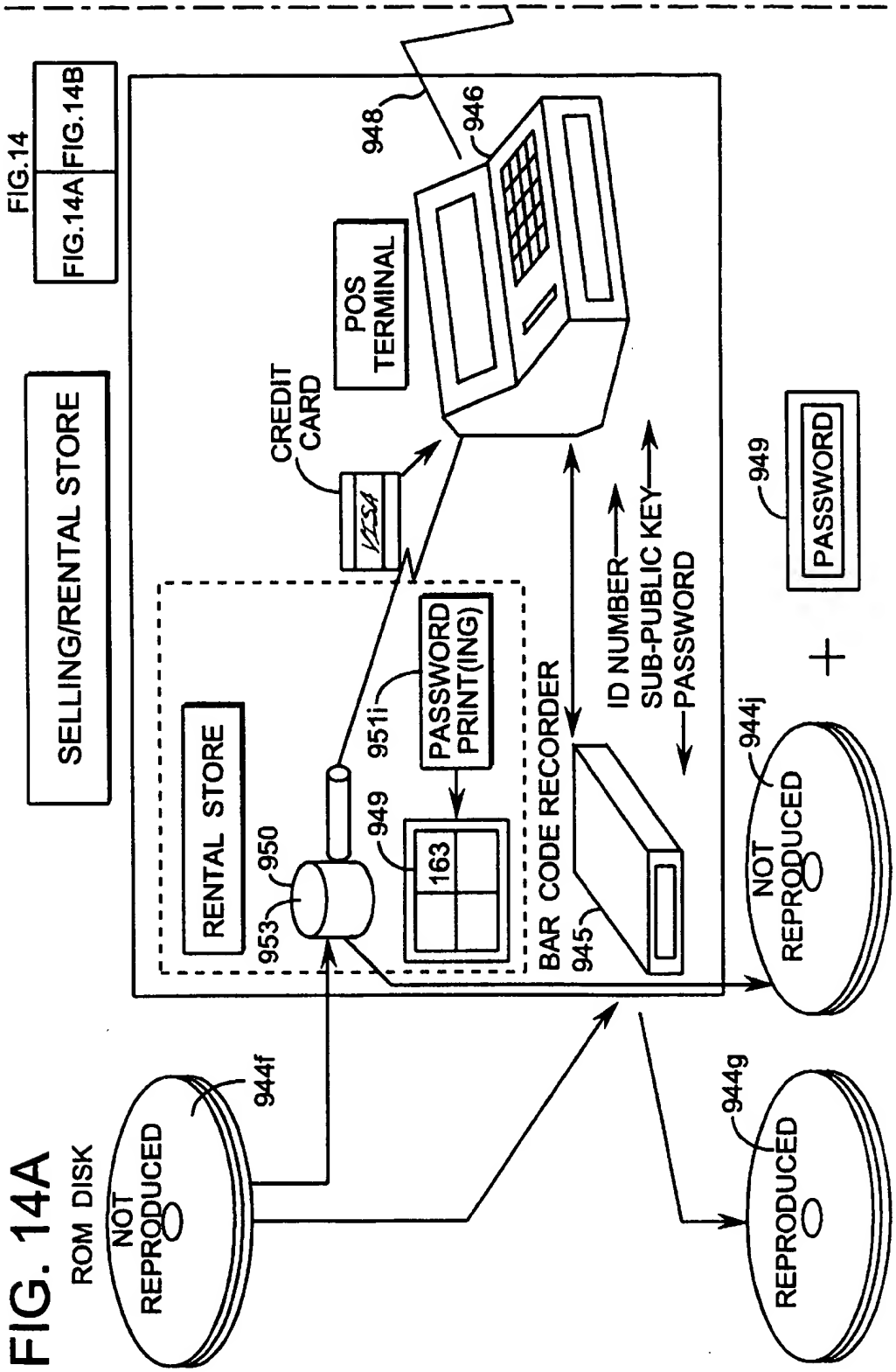


FIG.14
FIG.14A
FIG.14B
SELLING/RENTAL STORE
RENTAL STORE
948
946
POS TERMINAL
CREDIT CARD
951i
PASSWORD PRINT(ING)
949
950
953
163
BAR CODE RECORDER
945
ID NUMBER
SUB-PUBLIC KEY
PASSWORD
949
PASSWORD
944j
NOT REPRODUCED
944f
ROM DISK
NOT REPRODUCED
944g
REPRODUCED

FIG. 14A

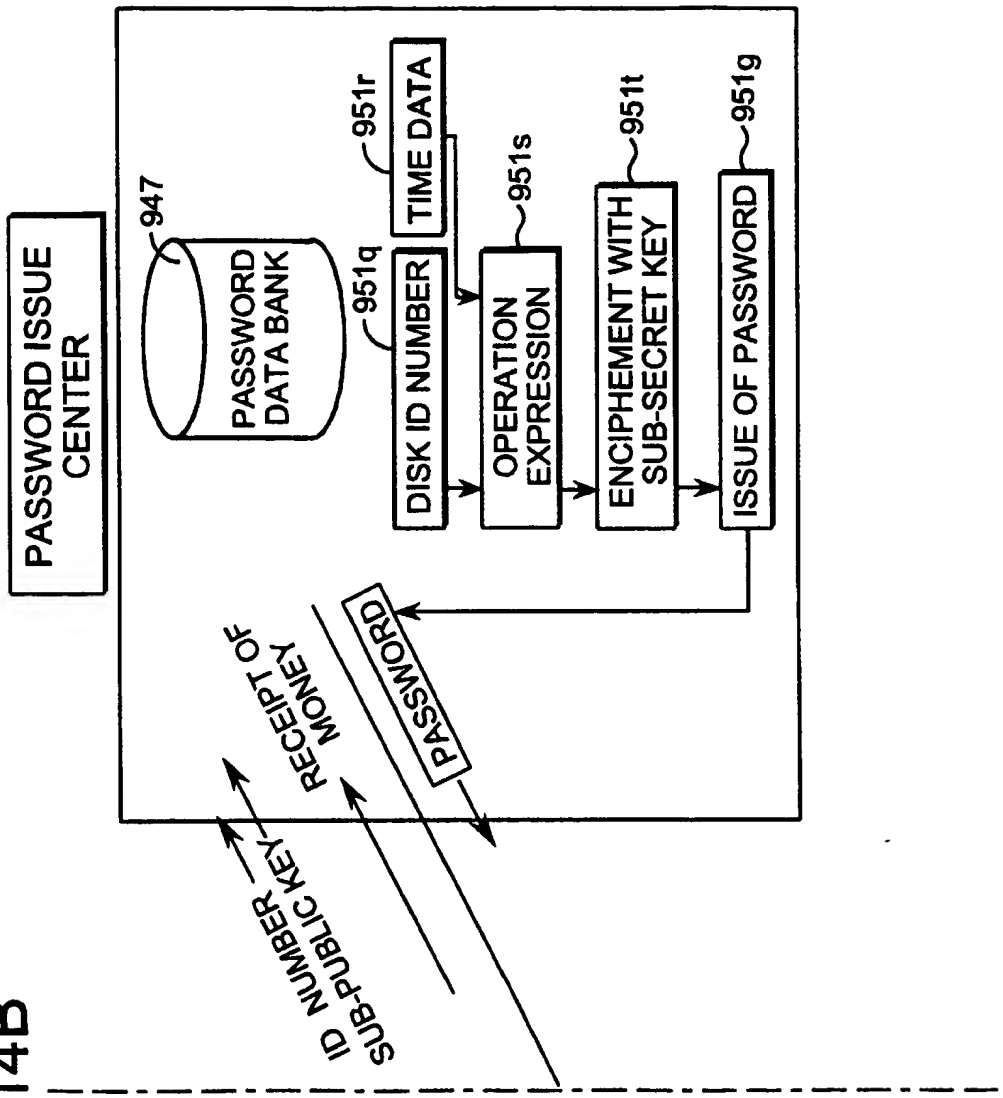

PASSWORD ISSUE CENTER
947
PASSWORD DATA BANK
951q
DISK ID NUMBER
951r
TIME DATA
951s
OPERATION EXPRESSION
951t
ENCIPHEMENT WITH SUB-SECRET KEY
951g
ISSUE OF PASSWORD
PASSWORD
RECEIPT OF MONEY
ID NUMBER
SUB-PUBLIC KEY

FIG. 14B

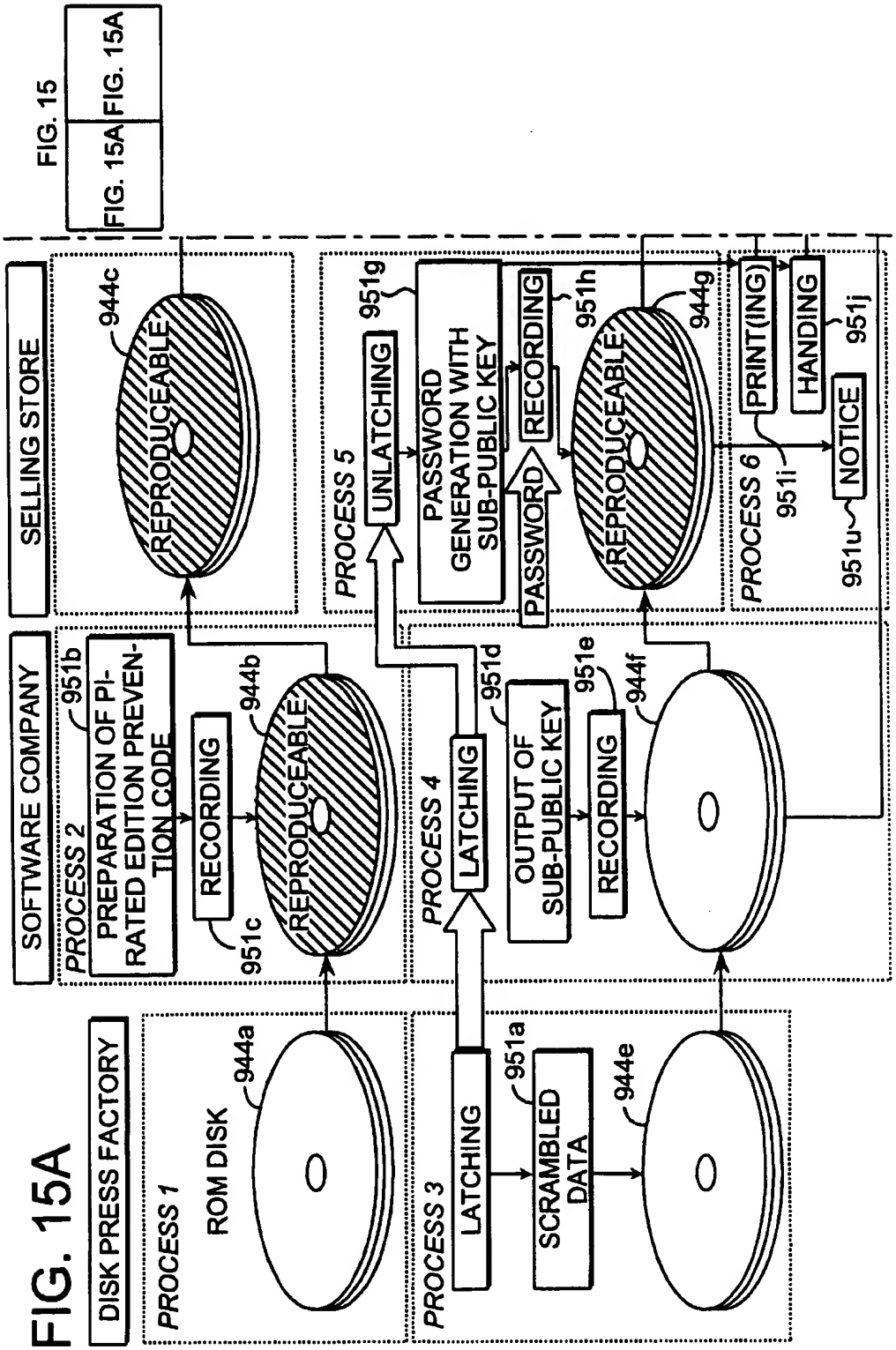


FIG. 15
FIG. 15A
FIG. 15A
DISK PRESS FACTORY
SOFTWARE COMPANY
SELLING STORE
PROCESS 1
ROM DISK
944a
PROCESS 2
951b
PREPARATION OF PIRATED EDITION PREVENTION CODE
RECORDING
951c
944b
REPRODUCEABLE
PROCESS 3
LATCHING
951a
SCRAMBLED DATA
944e
PROCESS 4
LATCHING
951d
OUTPUT OF SUB-PUBLIC KEY
951e
RECORDING
944f
944c
REPRODUCEABLE
PROCESS 5
951g
UNLATCHING
PASSWORD GENERATION WITH SUB-PUBLIC KEY
RECORDING
951h
PASSWORD
944g
REPRODUCEABLE
PROCESS 6
PRINT(ING)
HANDING
951j
951i
NOTICE
951u

FIG. 15A

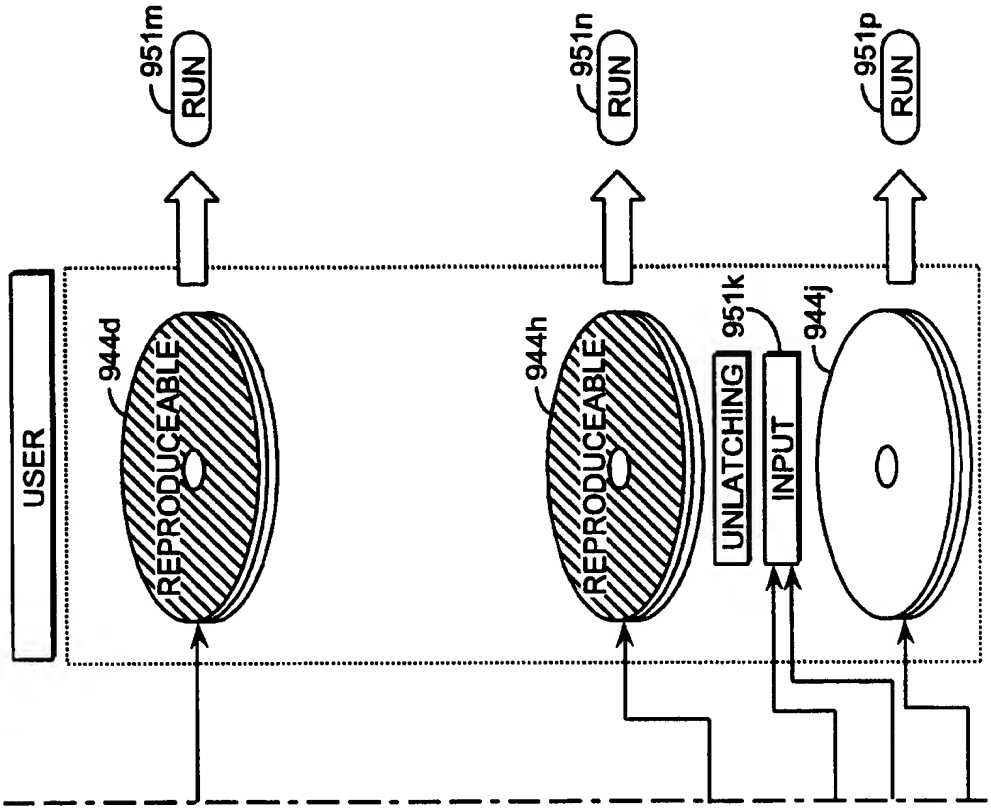

951m
RUN
951n
RUN
951p
RUN
USER
944d
REPRODUCEABLE
944h
REPRODUCEABLE
951k
UNLATCHING
INPUT
944j

FIG. 15B

FIG. 16

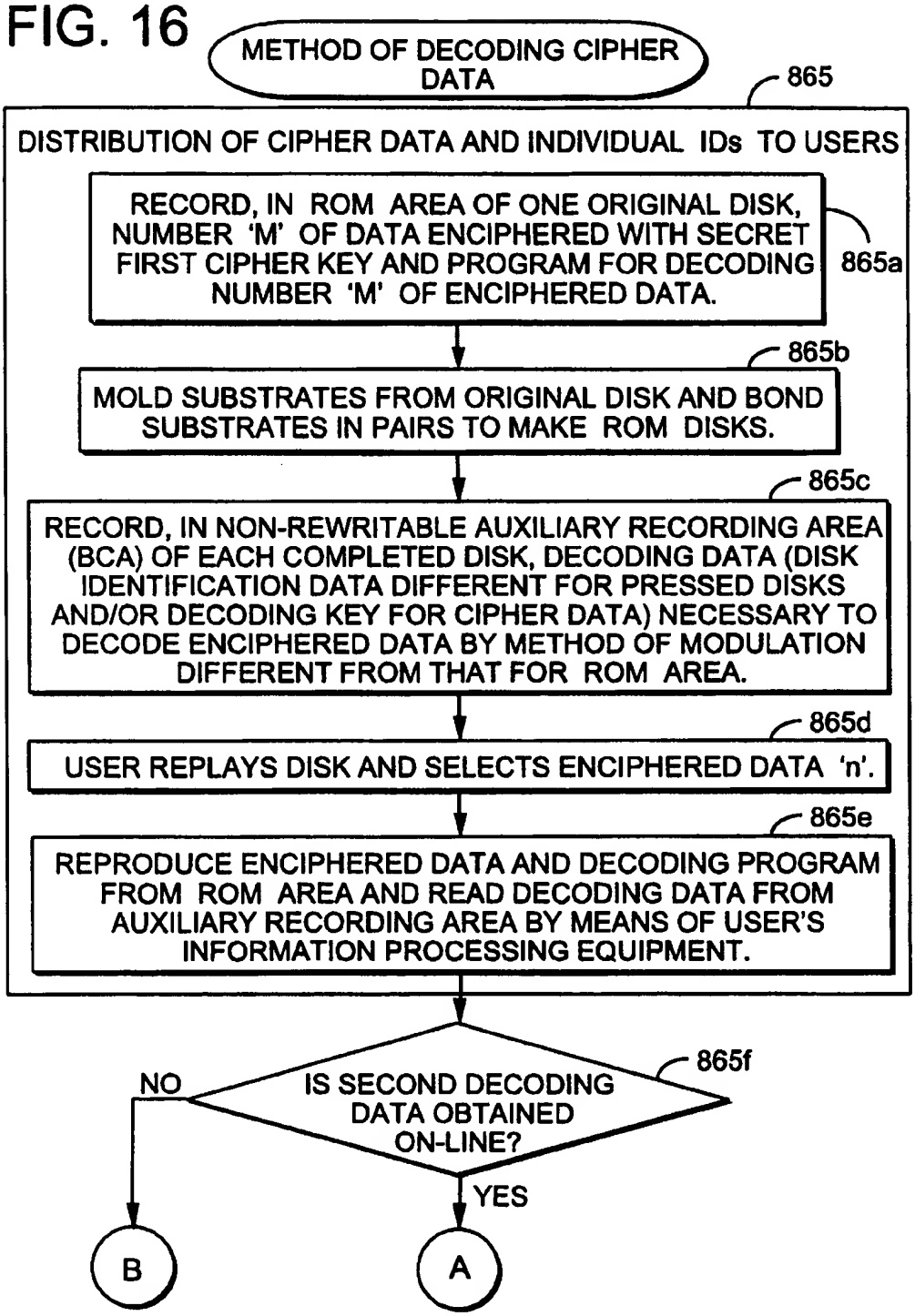

METHOD OF DECODING CIPHER DATA
865
DISTRIBUTION OF CIPHER DATA AND INDIVIDUAL IDs TO USERS
RECORD, IN ROM AREA OF ONE ORIGINAL DISK, NUMBER 'M' OF DATA ENCIPHERED WITH SECRET FIRST CIPHER KEY AND PROGRAM FOR DECODING NUMBER 'M' OF ENCIPHERED DATA.
865a
865b
MOLD SUBSTRATES FROM ORIGINAL DISK AND BOND SUBSTRATES IN PAIRS TO MAKE ROM DISKS.
865c
RECORD, IN NON-REWRITABLE AUXILIARY RECORDING AREA (BCA) OF EACH COMPLETED DISK, DECODING DATA (DISK IDENTIFICATION DATA DIFFERENT FOR PRESSED DISKS AND/OR DECODING KEY FOR CIPHER DATA) NECESSARY TO DECODE ENCIPHERED DATA BY METHOD OF MODULATION DIFFERENT FROM THAT FOR ROM AREA.
865d
USER REPLAYS DISK AND SELECTS ENCIPHERED DATA 'n'.
865e
REPRODUCE ENCIPHERED DATA AND DECODING PROGRAM FROM ROM AREA AND READ DECODING DATA FROM AUXILIARY RECORDING AREA BY MEANS OF USER'S INFORMATION PROCESSING EQUIPMENT.
865f
IS SECOND DECODING DATA OBTAINED ON-LINE?
NO
YES
B
A

FIG. 17

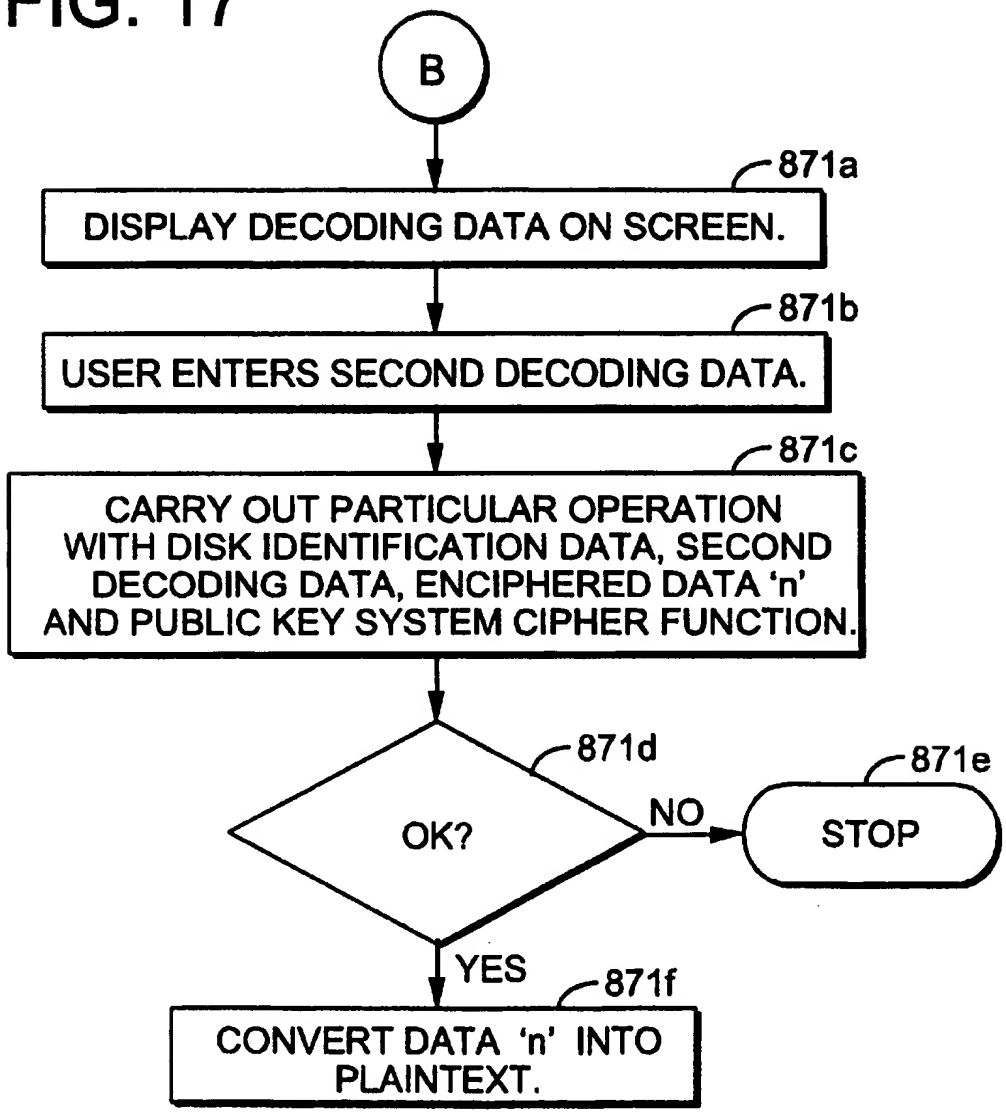

B
871a
DISPLAY DECODING DATA ON SCREEN.
871b
USER ENTERS SECOND DECODING DATA.
871c
CARRY OUT PARTICULAR OPERATION WITH DISK IDENTIFICATION DATA, SECOND DECODING DATA, ENCIPHERED DATA 'n' AND PUBLIC KEY SYSTEM CIPHER FUNCTION.
871d
OK?
NO
871e
STOP
YES
871f
CONVERT DATA 'n' INTO PLAINTEXT.

FIG. 18

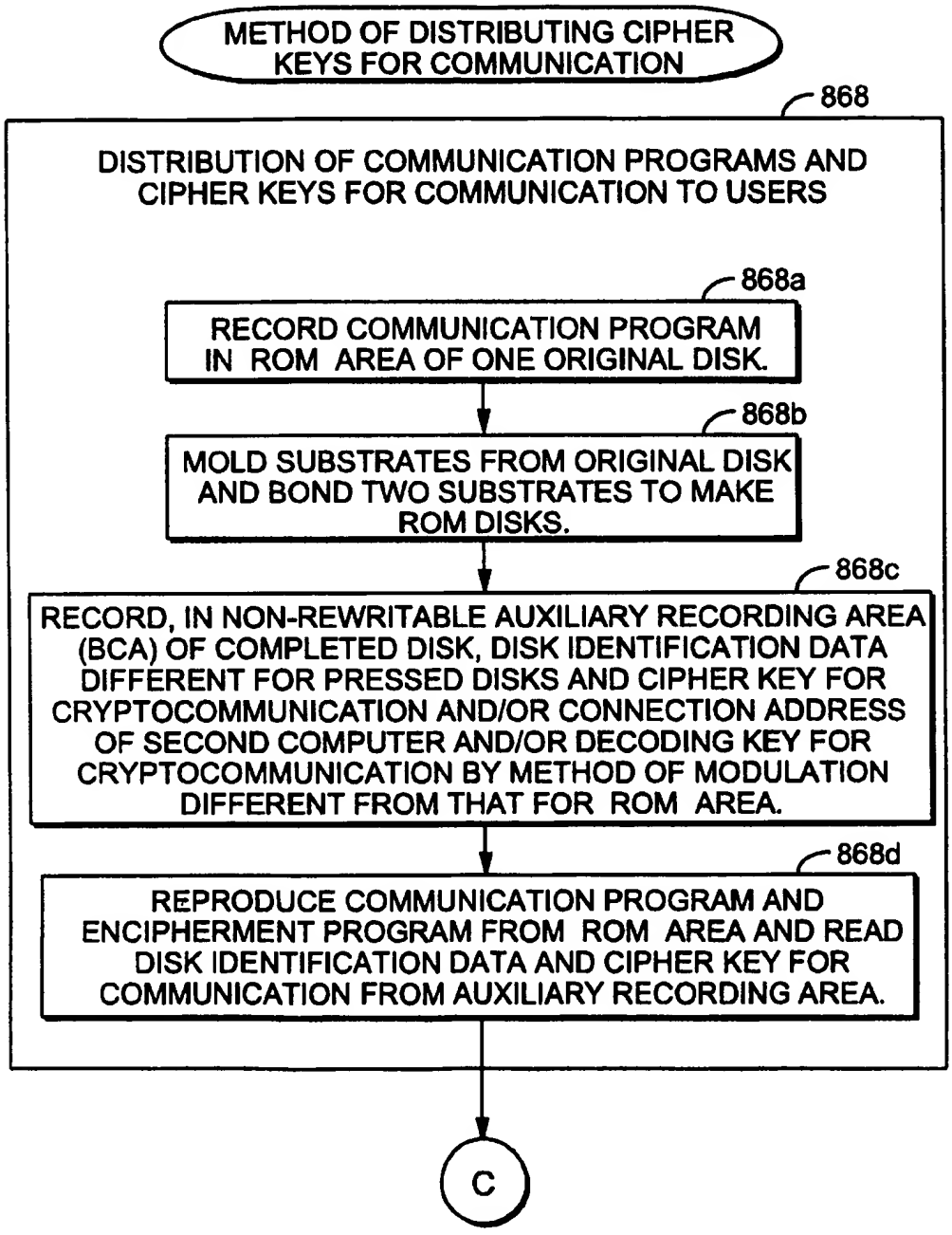

METHOD OF DISTRIBUTING CIPHER KEYS FOR COMMUNICATION
868
DISTRIBUTION OF COMMUNICATION PROGRAMS AND CIPHER KEYS FOR COMMUNICATION TO USERS
868a
RECORD COMMUNICATION PROGRAM IN ROM AREA OF ONE ORIGINAL DISK.
868b
MOLD SUBSTRATES FROM ORIGINAL DISK AND BOND TWO SUBSTRATES TO MAKE ROM DISKS.
868c
RECORD, IN NON-REWRITABLE AUXILIARY RECORDING AREA (BCA) OF COMPLETED DISK, DISK IDENTIFICATION DATA DIFFERENT FOR PRESSED DISKS AND CIPHER KEY FOR CRYPTOCOMMUNICATION AND/OR CONNECTION ADDRESS OF SECOND COMPUTER AND/OR DECODING KEY FOR CRYPTOCOMMUNICATION BY METHOD OF MODULATION DIFFERENT FROM THAT FOR ROM AREA.
868d
REPRODUCE COMMUNICATION PROGRAM AND ENCIPHERMENT PROGRAM FROM ROM AREA AND READ DISK IDENTIFICATION DATA AND CIPHER KEY FOR COMMUNICATION FROM AUXILIARY RECORDING AREA.
C

FIG. 19

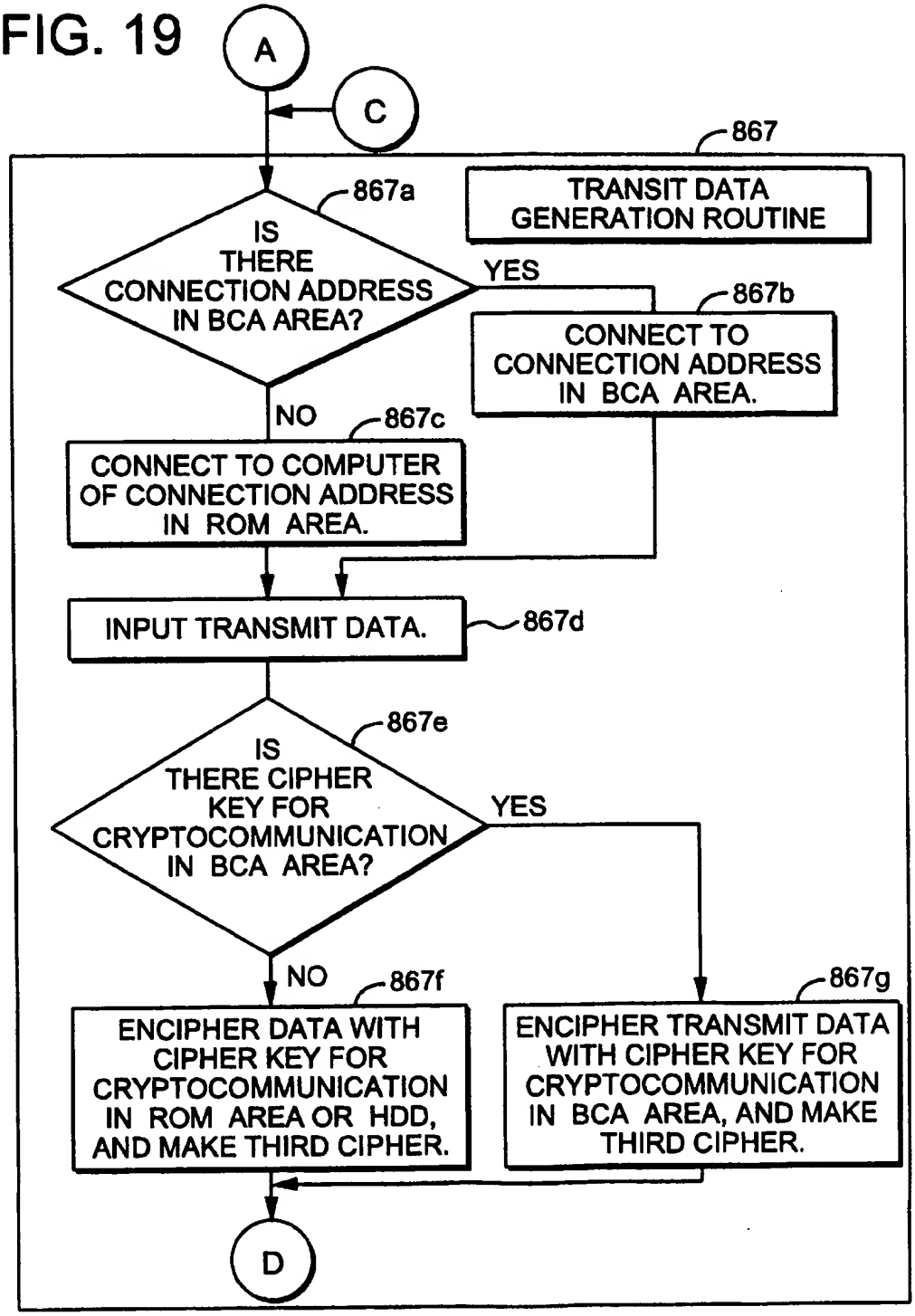

A
C
867
867a
IS THERE CONNECTION ADDRESS IN BCA AREA?
TRANSIT DATA GENERATION ROUTINE
YES
867b
CONNECT TO CONNECTION ADDRESS IN BCA AREA.
NO
867c
CONNECT TO COMPUTER OF CONNECTION ADDRESS IN ROM AREA.
INPUT TRANSMIT DATA.
867d
867e
IS THERE CIPHER KEY FOR CRYPTOCOMMUNICATION IN BCA AREA?
YES
NO
867f
ENCIPHER DATA WITH CIPHER KEY FOR CRYPTOCOMMUNICATION IN ROM AREA OR HDD, AND MAKE THIRD CIPHER.
867g
ENCIPHER TRANSMIT DATA WITH CIPHER KEY FOR CRYPTOCOMMUNICATION IN BCA AREA, AND MAKE THIRD CIPHER.
D

FIG. 20A

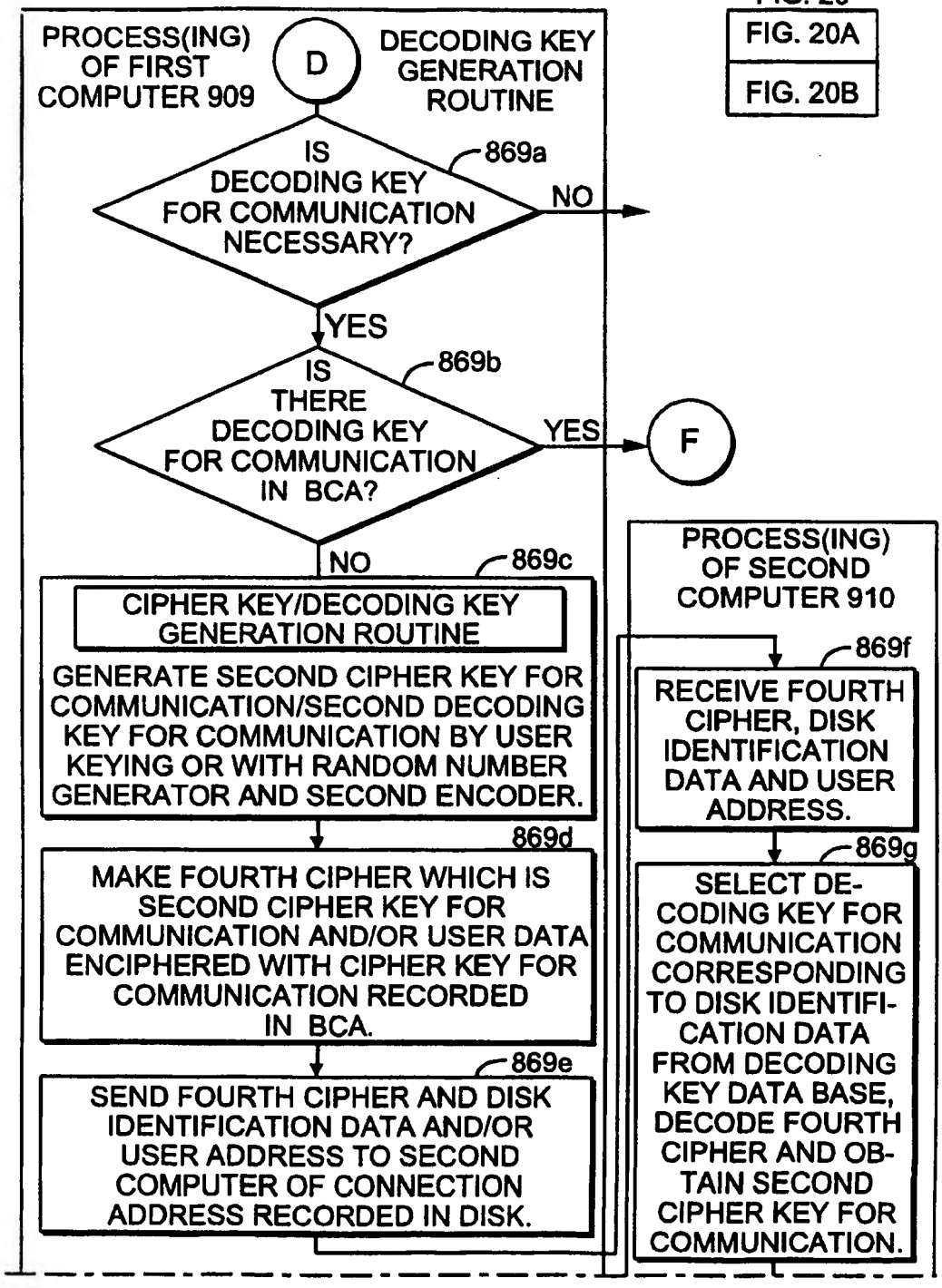


FIG. 20
FIG. 20A
FIG. 20B

FIG. 20B

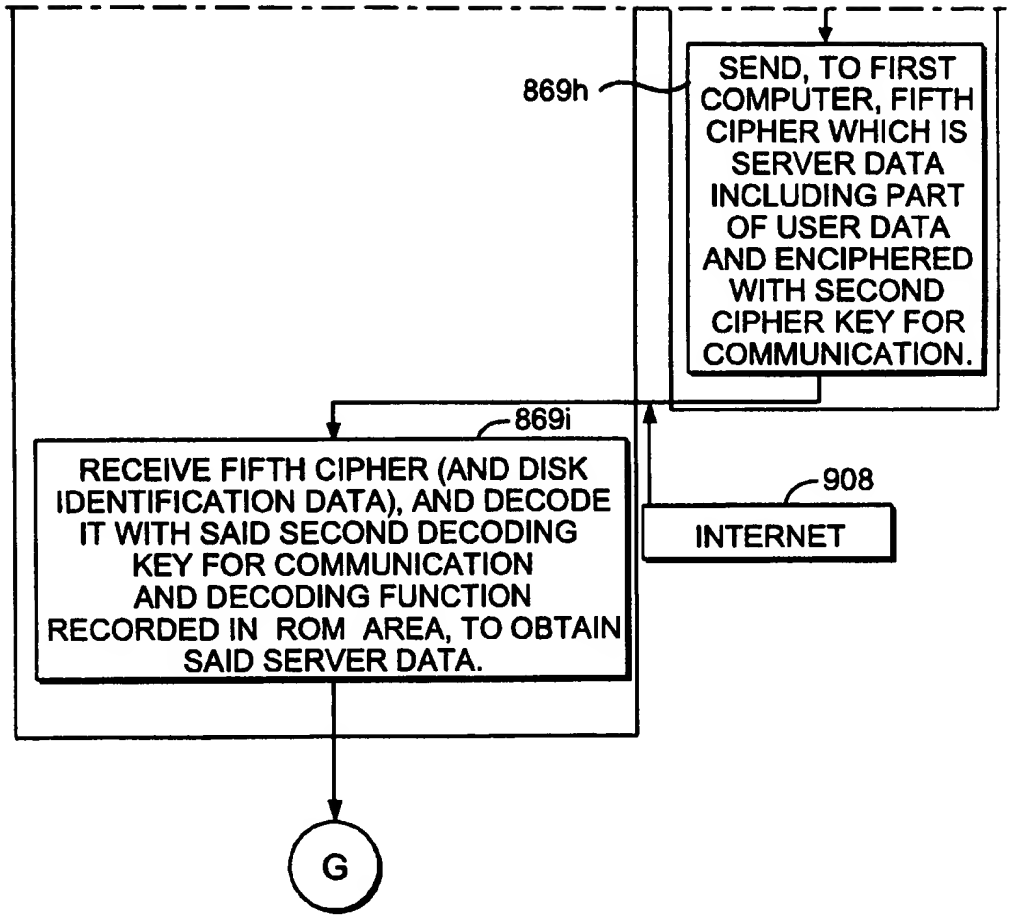

869h
SEND, TO FIRST COMPUTER, FIFTH CIPHER WHICH IS SERVER DATA INCLUDING PART OF USER DATA AND ENCIPHERED WITH SECOND CIPHER KEY FOR COMMUNICATION.
869i
RECEIVE FIFTH CIPHER (AND DISK IDENTIFICATION DATA), AND DECODE IT WITH SAID SECOND DECODING KEY FOR COMMUNICATION AND DECODING FUNCTION RECORDED IN ROM AREA, TO OBTAIN SAID SERVER DATA.
908
INTERNET
G

FIG. 21A

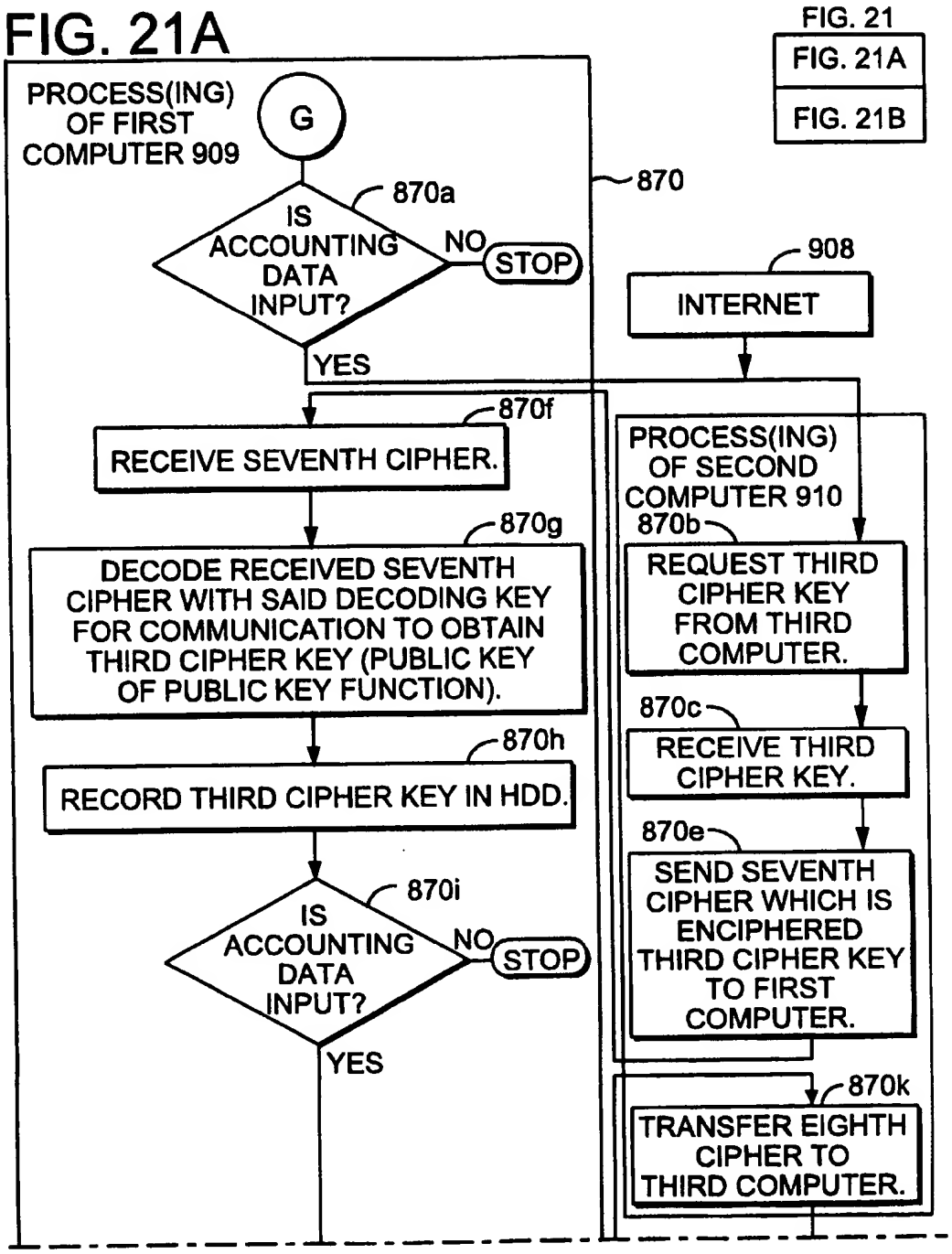


FIG. 21
FIG. 21A
FIG. 21B

FIG. 21B

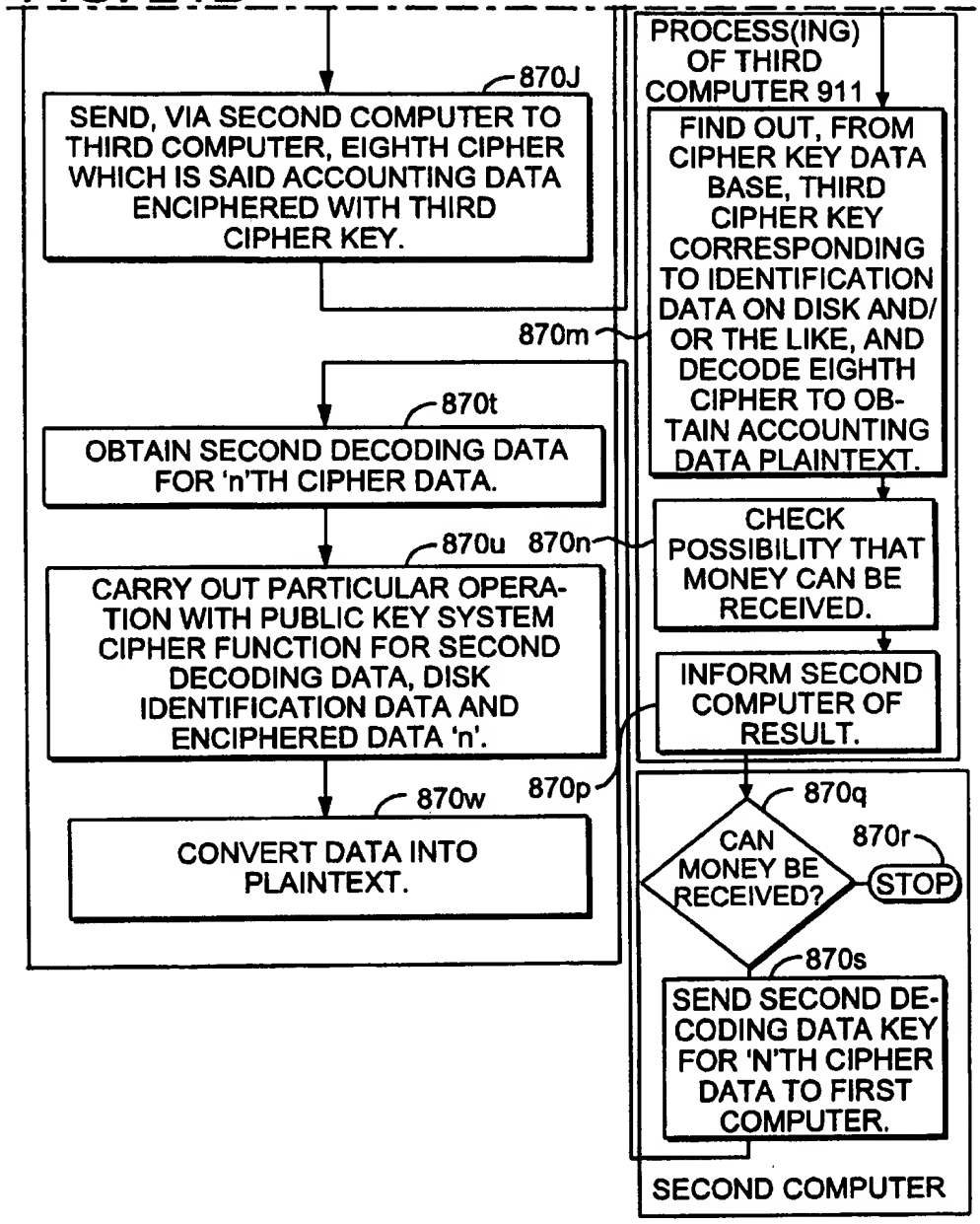

PROCESS(ING) OF THIRD COMPUTER 911
870J
SEND, VIA SECOND COMPUTER TO THIRD COMPUTER, EIGHTH CIPHER WHICH IS SAID ACCOUNTING DATA ENCIPHERED WITH THIRD CIPHER KEY.
870m
FIND OUT, FROM CIPHER KEY DATA BASE, THIRD CIPHER KEY CORRESPONDING TO IDENTIFICATION DATA ON DISK AND/ OR THE LIKE, AND DECODE EIGHTH CIPHER TO OBTAIN ACCOUNTING DATA PLAINTEXT.
870t
OBTAIN SECOND DECODING DATA FOR 'n'TH CIPHER DATA.
870u
870n
CARRY OUT PARTICULAR OPERATION WITH PUBLIC KEY SYSTEM CIPHER FUNCTION FOR SECOND DECODING DATA, DISK IDENTIFICATION DATA AND ENCIPHERED DATA 'n'.
CHECK POSSIBILITY THAT MONEY CAN BE RECEIVED.
INFORM SECOND COMPUTER OF RESULT.
870p
870w
CONVERT DATA INTO PLAINTEXT.
870q
CAN MONEY BE RECEIVED?
870r
STOP
870s
SEND SECOND DECODING DATA KEY FOR 'N'TH CIPHER DATA TO FIRST COMPUTER.
SECOND COMPUTER

FIG. 22A

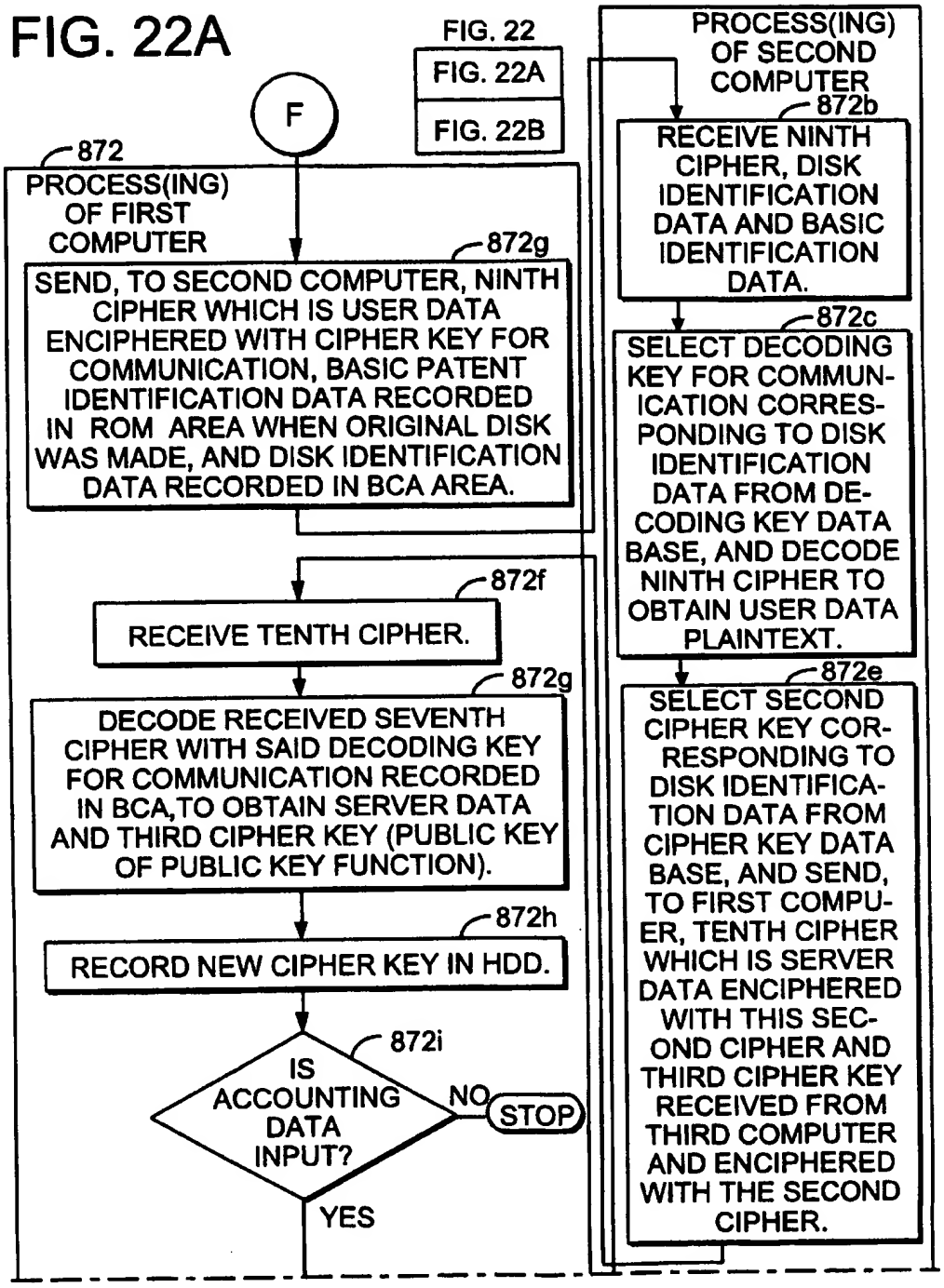


FIG. 22
FIG. 22A
FIG. 22B
F
872
PROCESS(ING) OF FIRST COMPUTER
872g
SEND, TO SECOND COMPUTER, NINTH CIPHER WHICH IS USER DATA ENCIPHERED WITH CIPHER KEY FOR COMMUNICATION, BASIC PATENT IDENTIFICATION DATA RECORDED IN ROM AREA WHEN ORIGINAL DISK WAS MADE, AND DISK IDENTIFICATION DATA RECORDED IN BCA AREA.
872f
RECEIVE TENTH CIPHER.
872g
DECODE RECEIVED SEVENTH CIPHER WITH SAID DECODING KEY FOR COMMUNICATION RECORDED IN BCA,TO OBTAIN SERVER DATA AND THIRD CIPHER KEY (PUBLIC KEY OF PUBLIC KEY FUNCTION).
872h
RECORD NEW CIPHER KEY IN HDD.
872i
IS ACCOUNTING DATA INPUT?
NO
STOP
YES
PROCESS(ING) OF SECOND COMPUTER
872b
RECEIVE NINTH CIPHER, DISK IDENTIFICATION DATA AND BASIC IDENTIFICATION DATA.
872c
SELECT DECODING KEY FOR COMMUNICATION CORRESPONDING TO DISK IDENTIFICATION DATA FROM DECODING KEY DATA BASE, AND DECODE NINTH CIPHER TO OBTAIN USER DATA PLAINTEXT.
872e
SELECT SECOND CIPHER KEY CORRESPONDING TO DISK IDENTIFICATION DATA FROM CIPHER KEY DATA BASE, AND SEND, TO FIRST COMPUTER, TENTH CIPHER WHICH IS SERVER DATA ENCIPHERED WITH THIS SECOND CIPHER AND THIRD CIPHER KEY RECEIVED FROM THIRD COMPUTER AND ENCIPHERED WITH THE SECOND CIPHER.

FIG. 22B

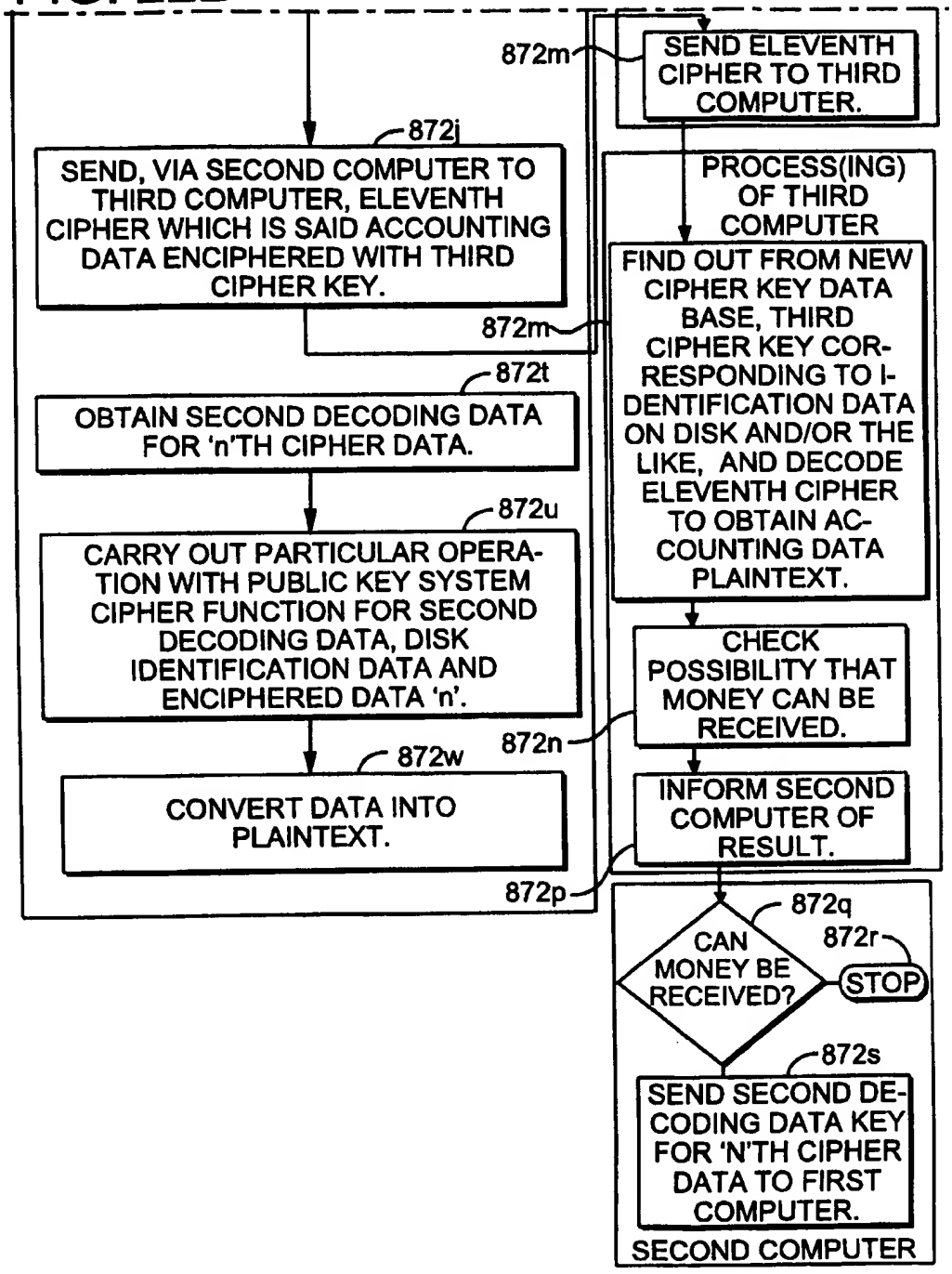

872m
SEND ELEVENTH CIPHER TO THIRD COMPUTER.
872j
SEND, VIA SECOND COMPUTER TO THIRD COMPUTER, ELEVENTH CIPHER WHICH IS SAID ACCOUNTING DATA ENCIPHERED WITH THIRD CIPHER KEY.
PROCESS(ING) OF THIRD COMPUTER
872m
FIND OUT FROM NEW CIPHER KEY DATA BASE, THIRD CIPHER KEY CORRESPONDING TO IDENTIFICATION DATA ON DISK AND/OR THE LIKE, AND DECODE ELEVENTH CIPHER TO OBTAIN ACCOUNTING DATA PLAINTEXT.
872t
OBTAIN SECOND DECODING DATA FOR 'n'TH CIPHER DATA.
872u
CARRY OUT PARTICULAR OPERATION WITH PUBLIC KEY SYSTEM CIPHER FUNCTION FOR SECOND DECODING DATA, DISK IDENTIFICATION DATA AND ENCIPHERED DATA 'n'.
CHECK POSSIBILITY THAT MONEY CAN BE RECEIVED.
872n
872w
CONVERT DATA INTO PLAINTEXT.
INFORM SECOND COMPUTER OF RESULT.
872p
872q
CAN MONEY BE RECEIVED?
872r
STOP
872s
SEND SECOND DECODING DATA KEY FOR 'N'TH CIPHER DATA TO FIRST COMPUTER.
SECOND COMPUTER

FIG. 23A

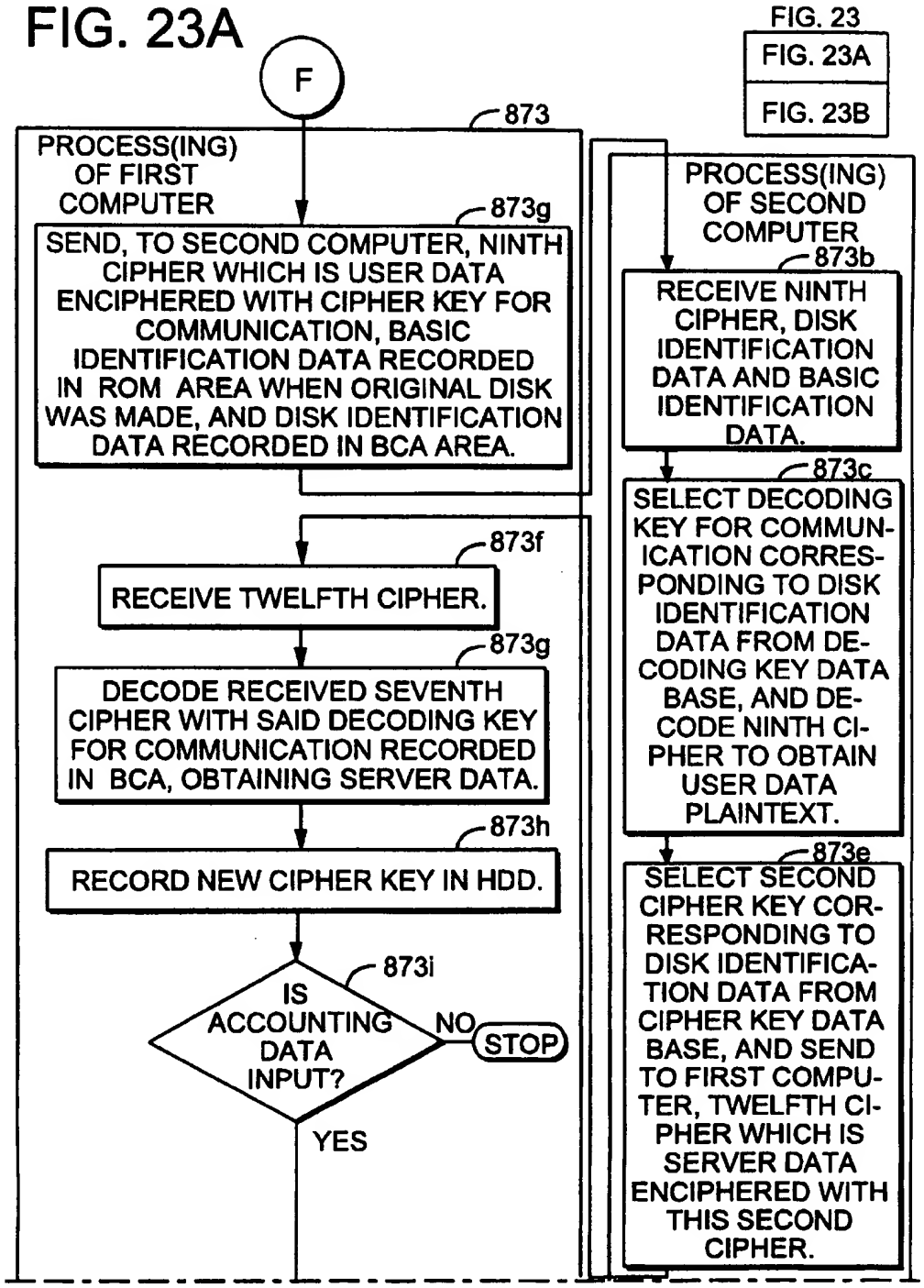
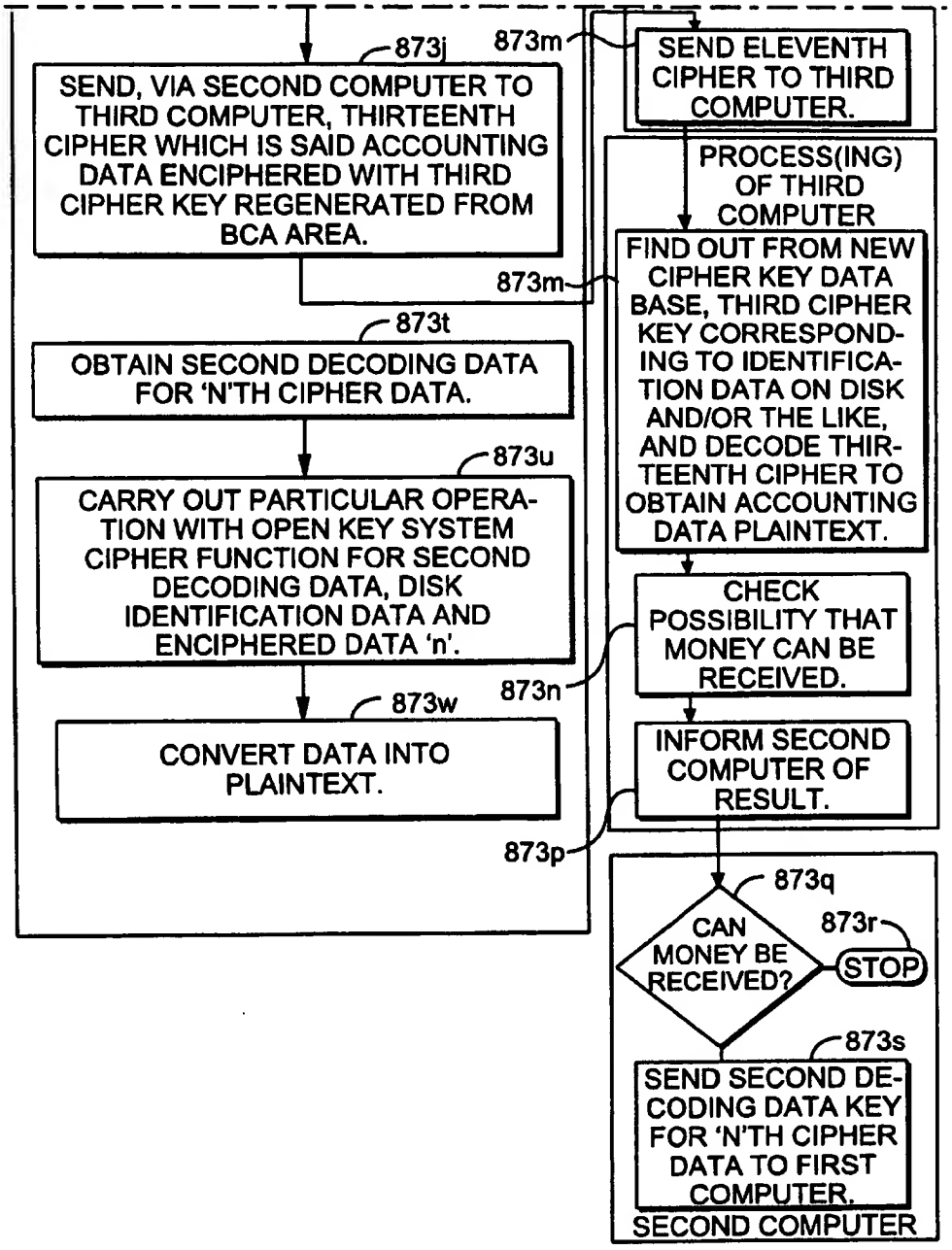


FIG. 23
FIG. 23A
FIG. 23B

FIG. 23B


873j
SEND, VIA SECOND COMPUTER TO THIRD COMPUTER, THIRTEENTH CIPHER WHICH IS SAID ACCOUNTING DATA ENCIPHERED WITH THIRD CIPHER KEY REGENERATED FROM BCA AREA.
873t
OBTAIN SECOND DECODING DATA FOR 'N'TH CIPHER DATA.
873u
CARRY OUT PARTICULAR OPERATION WITH OPEN KEY SYSTEM CIPHER FUNCTION FOR SECOND DECODING DATA, DISK IDENTIFICATION DATA AND ENCIPHERED DATA 'n'.
873w
CONVERT DATA INTO PLAINTEXT.
873m
SEND ELEVENTH CIPHER TO THIRD COMPUTER.
PROCESS(ING) OF THIRD COMPUTER
873m
FIND OUT FROM NEW CIPHER KEY DATA BASE, THIRD CIPHER KEY CORRESPONDING TO IDENTIFICATION DATA ON DISK AND/OR THE LIKE, AND DECODE THIRTEENTH CIPHER TO OBTAIN ACCOUNTING DATA PLAINTEXT.
873n
CHECK POSSIBILITY THAT MONEY CAN BE RECEIVED.
INFORM SECOND COMPUTER OF RESULT.
873p
873q
CAN MONEY BE RECEIVED?
873r
STOP
873s
SEND SECOND DECODING DATA KEY FOR 'N'TH CIPHER DATA TO FIRST COMPUTER.
SECOND COMPUTER

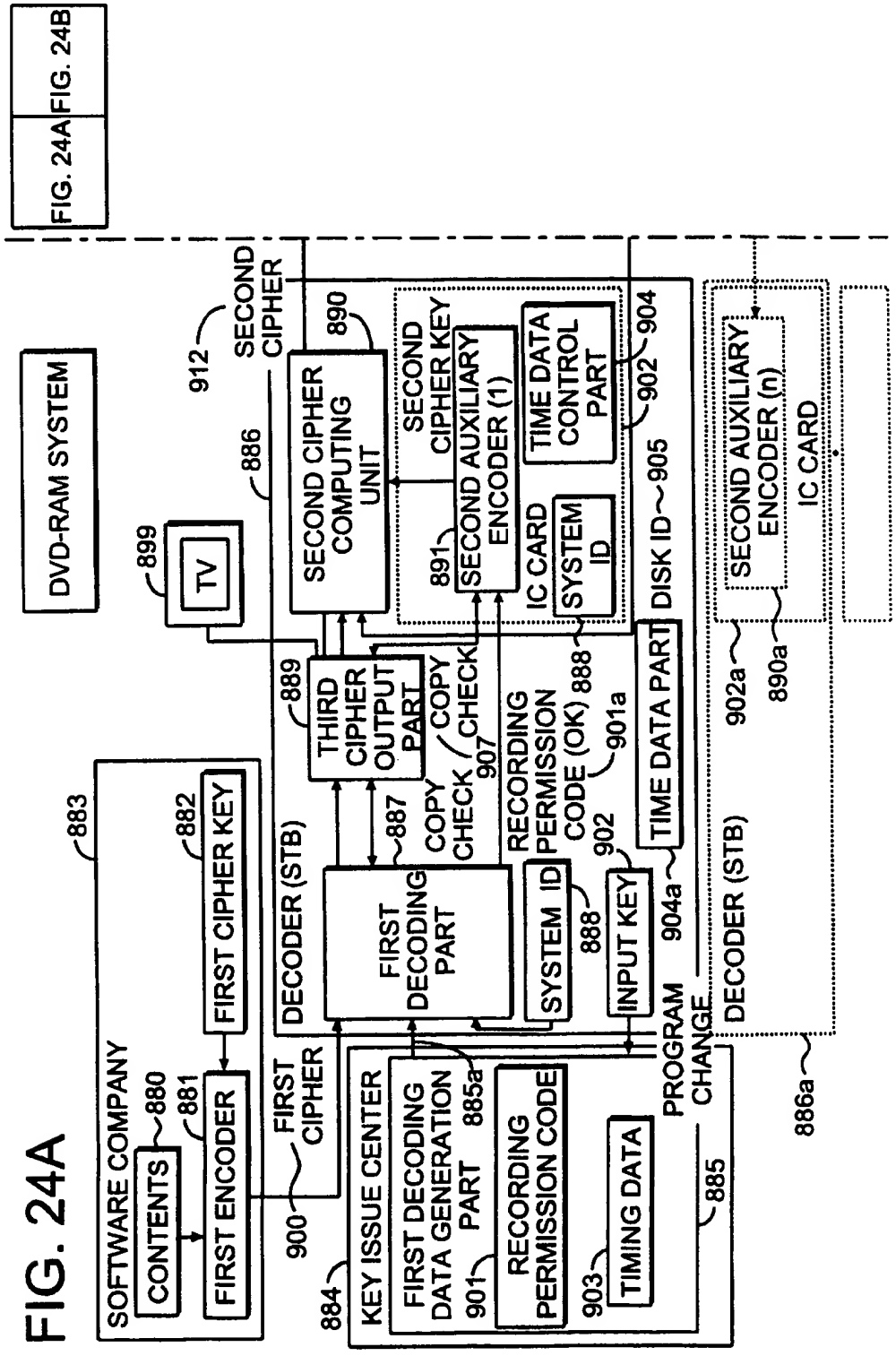


FIG. 24A
FIG. 24B
SOFTWARE COMPANY
CONTENTS
FIRST ENCODER
FIRST CIPHER KEY
FIRST CIPHER
KEY ISSUE CENTER
FIRST DECODING DATA GENERATION PART
RECORDING PERMISSION CODE
TIMING DATA
PROGRAM CHANGE
DECODER (STB)
FIRST DECODING PART
SYSTEM ID
INPUT KEY
TIME DATA PART
DISK ID
THIRD CIPHER OUTPUT PART
COPY CHECK
RECORDING PERMISSION CODE (OK)
DVD-RAM SYSTEM
TV
SECOND CIPHER
SECOND CIPHER COMPUTING UNIT
SECOND CIPHER KEY
SECOND AUXILIARY ENCODER (1)
IC CARD
SYSTEM ID
TIME DATA CONTROL PART
SECOND AUXILIARY ENCODER (n)
IC CARD
DECODER (STB)
883
880
881
882
900
884
885
885a
886
886a
887
888
889
890
891
901
901a
902
902a
903
904
904a
905
907
912

FIG. 24A

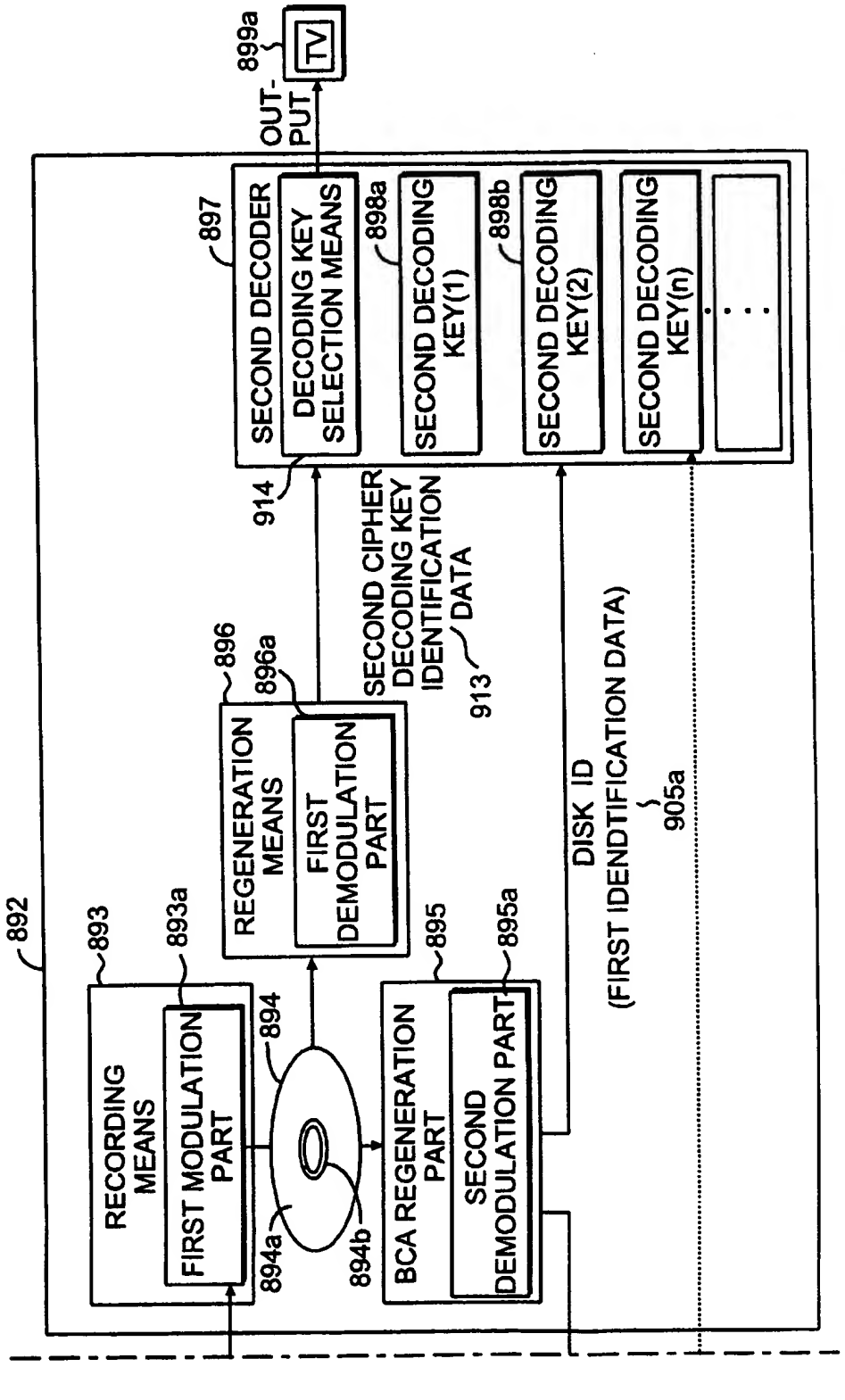

899a
TV
OUT-PUT
897
SECOND DECODER
DECODING KEY SELECTION MEANS
898a
SECOND DECODING KEY(1)
898b
SECOND DECODING KEY(2)
SECOND DECODING KEY(n)
914
SECOND CIPHER DECODING KEY IDENTIFICATION DATA
913
896
896a
REGENERATION MEANS
FIRST DEMODULATION PART
DISK ID
(FIRST IDENDTIFICATION DATA)
905a
892
893
893a
RECORDING MEANS
FIRST MODULATION PART
894
894a
894b
895
895a
BCA REGENERATION PART
SECOND DEMODULATION PART

FIG. 24B

OPTICAL DISK, OPTICAL RECORDER, OPTICAL REPRODUCER, CRYTOCOMMUNICATION SYSTEM AND PROGRAM LICENSE SYSTEM

TECHNICAL FIELD

The present invention relates to an optical disk, an optical disk system and a cryptocommunication method.

BACKGROUND

In recent years, with the increased use of networks such as the Internet and optical CD ROM disks, network soft key distribution for optical ROM disks has increased. Also, electronic commercial transactions have increased.

Soft key electronic distribution systems for CD-ROM media have been used. In conventional systems, it is known to give passwords and decipher the enciphered soft ciphers recorded on the CD-ROMs in advance. When CD-ROMs are used, however, it is not possible additionally to record on the disks, so that it is not possible to individually set IDs for respective disks. Therefore, one password would release the ciphers of all the disks manufactured from the same original disk. For this reason, when CD-ROMs are used, it is necessary to install the disks' IDs on the hard disks of personal computers, or mail to users IDs prepared centrally.

In electronic distribution systems with conventional optical disks and/or optical disk systems, there is a need to provide the disks and/or systems with IDs and/or cipher keys. It is an object of the present invention to simply provide IDs and cipher keys for ROM disks in electronic distribution systems.

SUMMARY OF THE INVENTION

To achieve the objects of the present invention, the pit portions of optical disks are provided with an additional recording area or Burst Cutting Area (hereinafter abbreviated as BCA) overwritten with a bar code and, when the disks are manufactured, IDs differing for each disk and, according to the need, cipher keys for communication and decoding keys for decoding key cipher texts for communication, are recorded individually in the BCA areas. As a result, when the disks have been distributed to users, the user ID numbers, the cipher keys for transmission for communication, and the decoding keys for reception are distributed automatically to the users. It is therefore possible to omit some of the procedures that complicate conventional systems. Also, cryptocommunication and the identification of disks are made possible at the same time.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a flow chart of an optical disk according to an embodiment of the present invention.

FIGS. 2*a–c* are cross sections and results of trimming with a pulse laser according to an embodiment of the invention.

FIGS. 3*a–g* show the signal reproduction waveforms at a trimming portion according to an embodiment of the invention.

FIG. 4 is a block diagram of a reproducer according to an embodiment of the invention.

FIG. 5*a* shows the waveform of a reproduced signal at a BCA part according to the invention. FIG. 5*b* shows dimensional relationships of a BCA part according to the invention.

FIG. 6 shows a method of cryptocommunication and a cipher key method by means of a password according to an embodiment of the present invention.

FIGS. 7*a–c* show the format of a BCA according to the invention.

FIG. 8 shows a method of cryptocommunication and a method of unlocking a cipher with a password according to an embodiment of the invention.

FIG. 9 shows a procedure for operation of a disk, the content part of which may have been licensed, according to an embodiment of the invention.

FIG. 10 is a block diagram of an example wherein a BCA has been recorded in a RAM disk according to an embodiment of the present invention.

FIG. 11 is a block diagram of a method or system for prevention of unauthorized copying according to an embodiment of the invention.

FIG. 12 is a flow chart depicting preventing unauthorized copying according to an embodiment of the invention.

FIG. 13*a* is a plan view and FIG. 13*b* is a cross section of an optical disk, on the BCA of which an article or commodity bar code has been printed, according to an embodiment of the invention. FIG. 13*c* shows a method or producing an optical disk according to an embodiment of the invention.

FIG. 14 is a block diagram of a POS settlement system with a ROM disk having a BCA and a POS terminal according to an embodiment of the invention.

FIG. 15 is a flow chart of cipher release in and between a press company, a software company and a selling store, according to an embodiment of the present invention.

FIGS. 16 and 17 are flow charts (Parts 1 and 2, respectively) of steps of enciphering and decoding cipher data with a disk ID and/or the like according to an embodiment of the invention.

FIGS. 18, 19 and 20 are flow charts (Parts 1, 2 and 3, respectively) of communication cipher key distribution and cryptocommunication with a BCA according to an embodiment of the invention.

FIGS. 21, 22 and 23 are flow charts (Parts 1, 2 and 3, respectively) of an electronic settlement system with a BCA according to an embodiment of the present invention.

FIG. 24 is a block diagram of a method of recording and reproducing for recording limitation to one RAM disk with a BCA according to an embodiment of the invention.

At the end of this specification is appended a list identifying items corresponding to the reference numerals used in the aforementioned drawings, that listing being in consecutive numerical order of the reference numerals.

DETAILED DESCRIPTION OF THE INVENTION

The present invention will be described on the basis of a number of embodiments. Herein, an additional recording area using the BCA system is referred to as a 'BCA area', and data recorded in a BCA is referred to as 'BCA data'. In addition, first identification data is referred to as 'ID' or 'disk ID'.

FIG. 1 shows a typical process for producing a disk with a BCA. The first cipher key **802**, such as a public key, is used by a cipher encoder or scrambler **803** to encipher contents **777** into the first cipher **805**. An 8–16 modulator **917**, such as a mastering unit, modulates the first cipher **805**. A laser records the modulated signal as pits in the first recording area **919** of an original disk **800**. A molding machine **808***a*

uses the original disk **800** to mold disk-like transparent substrates (not shown). A reflecting film making machine **808***b* forms reflecting Al films, and makes single-sided disks **809***a* and **809***b* which are each 0.6 millimeter thick. A bonding machine **808***c* laminates these disks together to make a completed disk **809**. A trimming unit **807** modulates the disk ID **921**, the first cipher decoding key **922**, or the second cipher key **923** for Internet communication in the second recording area **920** of the completed disk **809**, with a Phase Encoding-Return to Zero (PE-RZ) modulator **807***a*, which combines PE modulation and RZ modulation. A pulse laser **807***b* effects BCA trimming to make a disk **801** with a BCA. Because laminated disks are used, it is not possible to alter the BCA inside, and thus the completed disk can be used for security.

A BCA will next be explained briefly.

As shown in FIG. **2***a*, a pulse laser **808** trims the reflecting aluminum films of the two-layer disk **801** in a BCA to record a stripe-like low reflection part **810** on the basis of a PE modulating signal. As shown in FIG. **2***b*, BCA stripes are formed on the disk. If the stripes are reproduced by a conventional optical head, the BCA has no reflecting signal. Therefore, as shown in FIG. **2***c*, gaps **810***a*, **810***b* and **810***c* are produced, where the modulating signal is missing. The modulating signal is sliced at the first slice level **915**. But, the gaps **810***a–c* have a low signal level, and can therefore be sliced easily at the second slice level **916**. As shown with the recorded and reproduced waveforms in FIGS. **3***a–3g*, it is possible to reproduce the formed bar codes **923***a* and **923***b* by level-slicing them at the second slice level **916** by a conventional optical pickup as shown in FIG. **3***e*. As shown in FIG. **3***f*, the waveforms of the codes are shaped by a LPF filter so as to PE-RZ decode the codes. As shown in FIG. **3***g*, a digital signal is output.

With reference to FIG. **4**, the decoding operation will be explained. A disk **801** with a BCA includes two transparent substrates, which are laminated with a recording layer **801***a* between them. The recording layer may either be a single layer **801***a* or include two recording layers **800***a* and **800***b*. If there are two layers, a BCA flag **922** is recorded in the control data of the first recording layer **800***a*, which is adjacent to the optical head **6**. The flag **922** indicates whether a BCA is recorded or not. Because a BCA is recorded in the second layer **800***b*, the first recording layer **800***a* is focused on first, and the optical head **6** is moved to the radial position of the control data **924** in the innermost edge of the second recording area **919**. The control data is main data, and has therefore been Eight to Fourteen Modulation (EFM) 8–15 or 8–16 modulated. Only when the BCA flag **922** in the control data is '1', a single/double layer switching part **827** focuses on the second recording layer **800***b* to reproduce the BCA. If the signal is sliced by a level slicer **590** at the general first slice level **915** as shown in FIG. **2***c*, it is converted into a digital signal. This signal is demodulated in the first demodulation part by an EFM demodulator **925**, an 8–15 modulator-demodulator **926** or an 8–16 modulator-demodulator **927**. An ECC decoder **36** corrects errors, if any, and outputs main data. The control data in the main data is reproduced and only if the BCA flag **922** is 1 is the BCA read. When the BCA flag **922** is 1, a CPU **923** orders the single/double layer switching part **827** to drive a focus adjustment part **828**, switching the focus from the first recording layer **800***a* to the second recording layer **800***b*. At the same time, the optical head **6** is moved to the radial position of the second recording area **920**, that is, for the DVD standard, the BCA is recorded between 22.3 and 23.5 mm from the inner edge of the control data. Then the BCA is read. Reproduced in the BCA area is a signal with a partially missing envelope as shown in FIG. **2***c*. By setting in the second level slicer **929** the second slice level **916** of which the quantity of light is smaller than that of the first slice level **915**, it is possible to detect the missing parts of the reflecting portion of the BCA, and a digital signal is output. This signal is PE-RZ demodulated by the second demodulation part **930**, and ECC decoded by an ECC decoder **930***b* so as to output BCA data, which is auxiliary data. Thus, the first demodulator **928**, operative according to, 8–16 modulation demodulates and reproduces the main data, while the second demodulation part **930** operative according to PE-RZ modulation demodulates and reproduces the auxiliary data, that is, the BCA data.

FIG. **5***a* shows the reproduced waveform before passage through a filter **943**. FIG. **5***b* shows the working size accuracy (precision) of the slits of the low reflecting portion **810**. It is difficult to make the slit width less than 5 mm. In addition, if the data is not recorded inward radially from 23.5 mm, it will not be properly reproduced. Therefore, for a DVD, because of the limitations of the shortest recording cycle of 30 mm and the maximum radius of 23.5 mm, the maximum capacity after formatting is limited to 188 bytes or less.

The modulating signal is recorded as pits by the 8–16 modulation mode, and a high frequency signal such as the high frequency signal part **933** in FIG. **5***a* is obtained. However, the BCA signal is a low frequency signal like low frequency signal part **932**. Thus, if the main data complies with the DVD standard, it is a high frequency signal **932** which is about 4.5 MHz or less, shown in FIG. **5***a*, and the auxiliary data is a low frequency signal **933** which is 8.92 ms in period, that is, about 100 kHz. It is therefore relatively simple to frequency-separate the auxiliary data with a LPF **943**. A frequency-separating method **934** as shown in FIG. **4**, including the LPF **943** can easily separate the two signals. In this case, the LPF **943**, may be simple in structure.

The foregoing is an outline of the BCA.

With reference to FIG. **6**, the overall system of a cipher software unlatching system, narrowed down to the operations of password issue, cryptocommunication, and orderer certification, will be described. The steps in a press factory are nearly the same as in FIG. **1**, so the original disk **800** and the completed disk **809** are not shown.

In a press factory **811**, a cipher encoder **812** enciphers the data in the plaintexts **810** of the first to the '1- m'th contents or scrambles the picture signals therein with the first to '1-m'th cipher keys **813**, respectively. The data or the signals are then recorded on an original optical disk **800**. Disk-like substrates **809** are pressed from the original disk **800**. After a reflecting film is formed on each substrate **809**, the two disk-like substrates are laminated together. Thereafter a completed disk **809** is made. Recorded in the BCA areas **814** of completed disks **809** are different IDs **815** and/or first cipher keys **816** (public keys) and/or second cipher keys **817** (public keys) and second computer connection addresses **818** so as to make disks **801** each with a BCA. The disks **801** are distributed to users.

The contents of these disks have been enciphered. Therefore, in order to reproduce the contents of each of the disks, it is necessary to get a password from a password issue center, an electronic shop or a mall, by paying a charge. That procedure will be described next.

In a user's first computer **909**, if a reproducer **819** reproduces a distributed disk **801** with a BCA, a BCA reproduction part **820** including a PE-RZ demodulation part

reproduces the data of the ID **815**, first cipher key **816**, second cipher key **817** and/or connection address **818**. In order to get a password, the connection address **818** of the second computer **821***a*, which is the server of a password issue center **821**, is accessed through a communication part **822** via the Internet or another network **823**, and the ID is transmitted to the second computer **821***a*.

Here, the cryptocommunication procedure will be described. The second computer **821***a* receives the ID **815** from the user's reproducer **819**. Then, the second computer or server **821***a* of the password issue center **821**, which is called a 'mall' or an 'electronic shop' has a cipher key database **824**. This database contains a table of the secret keys which are the decoding keys corresponding to the disks' own IDs or the first cipher keys **816** of the IDs, that is the first decoding keys **825** and the IDs. The server can therefore search for the first decoding key **825** based on the received ID. Thus cryptocommunication is completed from the first computer to the second computer **821***a*. In this case, if the first cipher key and first decoding key are common keys of a common key cipher, not of an public key cipher, they are the same key.

If the user wants to use part of the enciphered contents stored on the disk **801**, which may be 1,000 in number, for example, the content number **826** of which is 'n', the user sends to the second computer **821***a* the cipher which is the content number **826**, that is, 'n' enciphered with the public key which is the first cipher key **816** by the first cipher encoder **827** composed of public key cipher functions. The second computer **821***a* searches for the first decoding key **825** for decoding this cipher as stated above. It is therefore possible securely to convert this cipher into plaintext. Thus, the cipher protects the privacy of the user's order data.

In this case, a signature may be made by means of the secret key of the public key cipher as the first cipher key **816**. This method is called 'digital signature'. For a detailed explanation of the operation of 'digital signature', see, for example, 'Digital Signature of E-Mail Security by Bruce Schneider 1995'.

Back to the cryptocommunication, the cipher is sent through the communication part **822** and network **823** to the first cipher decoder **827** of the password issue center **821**. Thus the first cipher decoder **827** decodes the cipher by means of the first pair cipher key **825** pairing with the first cipher key **816**.

In this case, because only the one disk has the public key, it is possible to reject invalid orders from third parties' disks. In other words, because each disk can be certified, it is possible to certify the user who owns the disk. It is thus certified that the content number 'n' represents a particular individual's order. It is therefore possible to exclude invalid orders of third parties.

If the public key **816** is secret, this method can technically be used to send a credit card number, or other accounting data which requires high security. Generally shops called 'malls' however, do not settle users' accounting data electronically, because there is no guarantee of security. Only the accounting centers **828** of credit card companies, banks and the like can deal with users' financial data. Presently, security standards such as secure electronic transaction (SET) are being unified, so it is probably that Rivest, Shamir and Adleman (RSA) 1024 bit public key ciphers will be used and the encipherment of financial data will be possible.

Next, the accounting data cryptocommunication procedure of the present invention will be shown. First, by using the second cipher key **817** of the public key cipher reproduced by the BCA reproduction part **820**, the second cipher encoder **831** ciphers the accounting data **830** such as an individual's credit card number with a public key system cipher such as RSA. The enciphered data is sent from the communication part **822** through the second computer **821** to the cipher decoder **832** of the third computer **828**. In this case, if there is a need for digital signature, the secret key **829** is used as the second cipher key **817**.

Similar to the procedure for the cipher key of the second computer **821***a* of the password issue center **821**, it is possible to search the cipher key database **824***a* for the second decoding key **829** corresponding to the ID or the second cipher key **817**. By using this decoding key **829**, the second cipher decoder **832** can decode the enciphered accounting data.

If a digital signature is made by the second cipher encoder **831** with the secret key **829**, the user's signature can be confirmed in the second cipher decoder **832**. The accounting center **828** can thus get the user's credit card number, bank card number, bank password, or other accounting data safely even via the Internet. In open networks such as the Internet, security comes into question. By means of this system, however, it is possible to make cryptocommunication or certification without fault, because the cipher key (public key) for cryptocommunication or the secret key for digital signature has been recorded in the BCA. It is therefore possible to prevent third parties' unauthorized accounting and orders. In addition, because it is possible to use various public keys for different disks, that is, different users, the confidentiality of communication is improved, and the possibility of users' accounting data leaking to third parties is reduced.

Referring back to FIG. **6**, the procedure for issuing a password and the procedure for unlatching with a password will be explained. The password issue center **821** includes a password generation part **834** with an operation expression of public key ciphers etc. Part **834** is accessed automatically, and merely by distributing disks with cipher keys recorded in the BCAs, security is possible for distribution of commodities by releasing the ciphers of contents, certification and keeping secret purchase of goods, certification and keeping secret when accounts are settled, and the like. Therefore, the method of cryptocommunication of the present invention can, without lowering security, omit and rationalize the conventional operations of using IC cards, floppy disks and/or letters to distribute IDs and/or cipher keys to users. This is a great advantage. Furthermore, a URL, which is an Internet connection address, is not fixed, but changeable. The URL is recorded in the original disk, and may be accessed. It is, however, not efficient from the points of view of time and cost to vary the original disk when a URL change is made. By having recorded the changed URL in the BCA, and connecting the BCA connection address **931** instead of the connection address of the original disk only if the connection address **931** is reproduced from the BCA, it is possible to access the changed address **931** without preparing a new original disk.

FIG. **6** shows a case where the first key of the public key and the second key of the public key have been recorded in the BCA.

FIG. **8** shows two diagrams, in one of which the first cipher key **816** of the public key and the third decoding key **817***a* of the secret key have been recorded in the BCA. In the other diagram, a cipher key is produced for cryptocommunication. Because the procedure is similar to that of FIG. **6**,

only different points will be described. First, in a press factory, the first cipher key **816** and third decoding key **817***a* are recorded in the BCA. The third decoding key **817***a* is used to receive the cipher

In this case, if the second timing data **835***b* of the clock **836***b* does not coincide with the first timing data **838** of the password, the cipher is not correctly decoded and therefore not reproduced. If timing data is used, it can be applied to time-limit type rental systems, so that a movie can be reproduced for only three days during a rental period.

While FIG. **6** shows the procedure in a block diagram, the flowcharts of the procedure will be explained later with references to FIGS. **16–23**.

Next, the system for the cipher key will be described. By putting, as shown in FIG. **7***a*, both the first cipher key **816** and second cipher key **817** in the BCA, it is possible to provide two securities, for a commodity deal with a shopping mall and an account settlement with an 'accounting center'.

In this case, with respect to the security with an accounting center, it is planned to unify standards such as SET, so that an RSA **1024**, that is 128 byte cipher key, will be stored in the second cipher key area **817***a*. Then, because the BCA has only 188 bytes, only 60 bytes remain for the cipher key for dealing with a shopping mall. An elliptic function system public key cipher is a cipher function which is 20 bytes in magnitude and which has a security level equal to that of 128 bytes of RSA **1024**.

An elliptic function is used in the first cipher key area **816***a* of the present invention. An elliptic function can obtain 20 byte security, which is equivalent to RSA **1024**. Therefore, by using an elliptic function, it is possible to store both the first cipher key **816** and second cipher key **817** in the 188 byte BCA area.

By applying a BCA to an optical ROM disk, as stated before, it is possible to record a disk's own ID number, the first and second cipher keys, and a connection address. In this case, if the Internet is used, a mall generates a password in the basis of three data fields, namely, the ID, the content number which the user wants to unlatch, and the time data representing the period of use allowed. The generated password is sent to the first computer **909**. In the simplest structure example, the second computer enciphers with the public key for the public key cipher the data which is a mix of the decoding key disk ID for releasing the cipher of the '1- n'th content and the timing data, prepares at the password generation part **834** the '1- n'th password **834***a* which is a mix of secret keys for unlatching the enciphered data, and sends this password **834***a* to the first computer **909**. The first computer **909** receives the '1- n'th password, and decodes with the secret key the mixed keys of the disk ID, the timing data and the '1- n'th content. Here, the password operation part **836** checks the ID **835***a* of the BCA reproduced from the disk, the present second timing data **835***b*, the allowed ID **833***a* and the first timing data **833**, and operates to determine if they coincide. If they do coincide, they are allowed. The '1- n'th decoding key **836***a* is output to the cipher decoder **837**. The cipher **837***a* of the '1- n'th content is decoded. The '1- n'th content **838** then is output. The period of output is limited to the time during which the first timing data **833** and second timing data **835***b* coincide. The password operation part **836** of the first computer **909** computes three data fields, which are the ID, the password **835** and the timing data from the clock **836***b* representing the present time. If the ID and timing data are correct, the correct decoding key is output as the result of the computation. Therefore, the cipher decoder **837** decodes or descrambles the '1- n'th cipher, outputting the plaintext data of the '1- n'th content **838**, or a descrambled picture signal or audio signal. enciphered with the public key from an accounting center. In this case, the reception security is improved.

First, with reference to FIG. **8**, a more specific example of cryptocommunication where a cipher key is generated will be described. Because the first cipher key **816** is a public key, it is necessary to record the third decoding key **817***a* for reception in the BCA. But the BCA has a small capacity. In addition, the public key needs processing time. Therefore, in FIG. **8**, the cipher key generation part **838***a* of the first computer **836** generates a pair of a cipher key and a decoding key for the public key or a common key by means of a random number generator or the like. An example of the common key will be described. A common key K **838** is enciphered with the first cipher key **816** and first cipher encoder **842**, and sent to the second computer **821***a*. The second computer uses the main decoding key **844** to convert this cipher into plaintext by means of the main cipher decoder **843**, obtaining a common key K **838***a*. Because both have the common key K, it is possible to make cryptocommunication from a shop to a user, that is, from the second computer **821***a* to the first computer **836** by delivering the common key K to the second cipher encoder **842***a* and second cipher decoder **847***a*. Naturally, it is also possible to make cryptocommunication from the user to the shop, that is, from the first computer **836** to the second computer **821***a* by delivering the common key K to the second cipher encoder **827***a* and second cipher decoder **845***a*. The effects of the method of recording in the BCA the first cipher key which is a public key and generating a cipher key will be stated. First, it is necessary only to record the first cipher key, so that the recording of the decoding key can be omitted. Therefore, the small capacity of the BCA is not reduced. Second, because the decoding key is recorded in the BCA, the security is improved. The common key may be changed each time.

Because of the short operation time, the processing time is short. In this case, if the cipher key generation part **838***a* has generated a pair of a cipher key and a decoding key of a public key cipher, not a common key, it is possible to make the security higher than that with the common key, though the processing time is longer, by cryptically sending the cipher key to the second computer **821***a*, using this key as the cipher key of the second cipher encoder **842***a*, and using the decoding key as the decoding key of the second cipher decoder **847**. If the performance of the processing CPU is high, it is preferable that the public key be used. If a new public key is generated, only the public key for the first cipher key is recorded in the BCA, so that no problems of security arise. No capacity of the BCA is consumed either. In addition, because it is not necessary to change the cipher key, maintenance is easy.

This time, if the common key K **838** is defined at the second computer **821***a* of the password issue center **821**, the common key is enciphered with the third cipher key **839** by the third cipher encoder **840**, and sent to the personal computer **836**. By using the third decoding key **837** which is the secret key reproduced from the BCA, the third cipher decoder **841** of the personal computer **836** makes a translation into plaintext to obtain a common key K **838***b*. In this case, because only this user has the third decoding key **817***a* which is the secret key, it is possible to prevent the contents of communication from the center to the user from leaking to third parties. The format of this case is shown in FIG. **7***b*. If an elliptic function is used, the third decoding key **839***b* may by 20 bytes, and can therefore be stored in the BCA.

FIG. 9 shows a system for reducing the costs of preparing an original disk by using a BCA in an encipherment disk.

If there is a number 'n' of, for example, 1,000 plaintext contents **850**, the cipher encoder **852** enciphers them with the first to the 'm'th cipher keys **851**, respectively. The ciphered first to the 'm'th contents **853**, the decoding program **854***a* for the first to 'm'th contents, and the second cipher decoder **861***a*, which is the program for decoding the second cipher, are recorded as pits in an original disk and then molded into a substrate, and a reflecting film is formed. Thereafter, two substrates are laminated together to complete an optical disk **801**. The second cipher encoder **860** enciphers the decoding data **854** such as the password for unlatching the '1- n'th, for example, the first content, and the decoding key. Recorded in advance in the BCA of the first disk are the disk's own identification data, that is, the ID **855** and the second cipher which is the enciphered decoding data. Then, in the reproducer, the second cipher is reproduced from the BCA reproduction part **820**. The second cipher decoder **861** is reproduced from the data reproduction part **862**, which reproduces the ordinary recorded data other than the BCA. Therefore, the second cipher decoder **861** is used to decode the second cipher, reproducing the ID **855***a* and '1- n'th password **854***a*. The cipher decoder **855***b* uses the decoding program **854***a* for the '1- n'th content reproduced from the data reproduction part **862**, and uses the ID **855***a* and password **854***a* to decode the first cipher, obtaining the plaintext **855***c* of the '1- n'th content and the identification data **855***a*. For a personal computer, the content and ID are recorded on the hard disk **863**. This ID **855***a* checks to determine if there is no same ID on a network when the program has started, and the ID **855***a* actuates the network protection. It is therefore possible to prevent the software from being illegally installed. This is yet another advantage of the present invention. For example, if 1,000 enciphered contents are stored and decoding data such as a password corresponding to a particular software applications are recorded on an original disk, this is equivalent in substance to the preparation of an optical ROM disk for a particular content. It is possible to obtain with one original disk the same effect as in the case where original disks for 1,000 kinds of software are cut. It is therefore possible to reduce the costs and time or labor for preparing an original disk.

Described with reference to FIG. **10** is the procedure for enciphering contents with a BCA when recording them on a RAM disk. First, the BCA reproduction part **820** reproduces the BCA data from the RAM disk **856**, outputs an ID **857**, and sends it through the interfaces **858***a* and **858***b* and the network to the encipherment part **859**. The cipher encoder **861** of the encipherment part **859** enciphers contents **860** or scrambles picture and sound signals by means of a key including the ID **857**. The enciphered contents are sent to the recorder/reproducer, where the recording circuit **862** records them on the RAM disk **856**.

Next, when this signal is reproduced, the data reproduction part **865** demodulates the main data to reproduce the enciphered signal, and the cipher decoder **863** decodes the reproduced signal. The BCA reproduction part **820** reproduces data containing the ID **857** from the BCA area of the ram disk **856**. The reproduced data is sent as part of the key to the cipher decoder **863**. If normally copied, the cipher key recorded in the RAM disk is a normal disk ID. The RAM disk ID, also, is a normal disk ID. Therefore, the cipher is decoded or descrambled to output the plaintext **864** of the '1- n'th content. For a graphic data, for example, the MPEG signal is extended to obtain a picture signal.

In this case, the disk ID is the key for encipherment. Because each disk is unique, it can be copied on only one RAM disk.

If a disk ID is copied from a normal RAM disk to another RAM disk, ID1 which is the original normal disk ID differs from ID2 which is the disk ID of the other, unauthorized, RAM disk. If the BCA of the unauthorized RAM disk is reproduced, ID2 is reproduced. The contents are ciphered with ID1, however, so that, even if unlatching is attempted with ID2 at the cipher decoder **863**, the cipher is not decoded because the key differs. Thus, the signal of the illegally copied RAM disk is not output, so that the copyright is protected. The present invention uses a disk ID system. Therefore, by reproducing with any drive the normal RAM disk copied normally only once, it is possible to unlatch the cipher. The encipherment part **859** may, in place of the center, be an IC card with a cipher encoder.

with reference to the block diagram of FIG. **11** and the flowchart of FIG. **12**, the method of preventing copying will be described. At Step **877***a*, the installation program is actuated. At Step **877***b*, the BCA reproduction part **820** outputs the ID of the auxiliary data from the laminated optical disk **801**. At Step **877***d*, the data reproduction part **865** reproduces the contents and network check software **870** from the main data. The contents and the ID **857** are recorded on the HDD **872**. At Step **877***c*, the ID **857** is encoded with a particular secret cipher so as not to be altered illegally, and is recorded as a soft ID in the HDD **857**. Thus, the soft ID **873** is recorded together with the contents on the HDD **872** of a personal computer **876**. Here described is the case where the program is started at Step **877***f* of FIG. **12**. When the program is started, the procedure goes to Step **877***g*, where the soft ID **873** of the HDD **872** is reproduced, and the soft ID **873***a* in the HDD **872***a* of another personal computer **876***a* on a network **876** is checked through the interface **875**. At Step **877***h*, a check is made to judge if the soft ID **873***a* of the other personal computer and the soft ID **873** are the same number. If so, the procedure goes to Step **877***j*, where the start of the program of the personal computer **876** is stopped or a warning message is displayed on the screen.

If the soft ID **873***a* of the other personal computer and the soft ID **873** are different, the contents are not installed in the plurality of the computers on the network. It is therefore decided that there are no illegal copies. Then the procedure goes to Step **877***k*, where the start of the program is permitted. In this case, the soft ID **873** may be sent to other personal computers through the network. This personal computer can detect illegal installation by checking duplication of the soft IDs of the personal computers. If there is illegal installation, a warning message is sent to the appropriate personal computer/s.

Thus, by recording the ID in the BCA, and recording the network check program in the pit recording area, it is possible to prevent multiple installation of the software of the same ID on the same network. In this way, simple protection from illegal copies is realized.

By, as shown in FIG. **13***a*, applying a write (writing) layer **850** of white material, on which characters or the like can be written, it is possible to not only print characters and write a password or the like with a pen, but also prevent the substrates of the optical disk from being damaged because the write layer **850** thickens. The disk ID **815**, which is part of the BCA data **849** recorded by trimming in the BCA area **801***a* above the write layer **850**, is translated into plaintext. The plaintext is converted into alphanumeric characters **851**. By printing the characters **851** and general bar code **852**, it is possible for the store and/or user to confirm and/or check the ID with a POS bar code reader and/or visually, without reading the BCA with a reproducer. The visible ID is not

necessary if the user informs the center of the ID through a personal computer. If, however, the user communicates the ID aurally by telephone to the center, it is possible to inform the center of the ID without inserting the disk in a personal computer, by printing the ID identical with the BCA ID in visible form on the disk, because the user can visually read the ID. With reference to the flowchart of FIG. **13***c*, the steps for making an optical disk will be explained. At Step **853***d*, disks are molded from an original disk, and substrates in which pits have been recorded are made. At Step **853***e*, aluminum reflection films are made. At Step **853***f*, two disk substrates are laminated with an adhesive so that a DVD disk or the like is completed. At Step **853***g*, a label is printed by screen printing on one side of each disk. At this step, the original disk's own identification data is recorded in the form of a bar code. At Step **853***h*, an ID and/or other identification information is printed in the format of a bar code for POS on each disk by an ink jet bar code printer or a thermal-transcription bar code printer or the like. At Step **853***i*, the bar code is read by a bar code reader. At Step **853***j*, a BCA data corresponding to the identification data is recorded in the second recording area of the disk. According to this method of manufacturing, the BCA data is recorded after all the steps including the POS bar code and excluding the BCA are finished and then the disk identification data is confirmed. The BCA can be read only by reproducing the disk, but the POS bar code, which is low in density, can be read by a commercial bar code reader. The disk ID can be discriminated at every step in the factory. By recording the disk ID in the form of a POS bar code before the BCA trimming, it is possible to almost completely prevent the BCA and the POS bar code from being illegally recorded.

The method of using a BCA will be stated by which secondary recording and tertiary recording, too, can be made by the BCA method. As shown at Process **2** in FIG. **15**, a software maker can also secondarily record a pirated edition prevention mark and a check cipher. At Process **2**, disks **944***b* may be made in which different ID numbers and/or cipher keys for secret communication with users have been recorded. It is possible to replay the disks **944***c* and **944***d* without entering the passwords.

For another application, at Process **3**, an enciphered or scrambled MPEG picture signal and/or other data is recorded on a disk **994***e*. The operation of the MPEG scramble will not be explained in detail. At Process **4**, the software company makes a disk **844***f* in which a sub-public key for decoding the ID number and the scramble release data have been BCA-recorded secondarily. It is not possible to replay this disk solely. At Process **5**, the selling store, after receiving the money for the disk, makes a password with the sub-secret key paired with the sub-public key, and records it tertiarily on the disk. Alternatively, a receipt on which the password has been printed is given to the user. Thereafter, the password has been recorded in the disk **844***g*, so that the user can replay it. This method prevents a disk not paid for from being replayed normally, even if the disk is shoplifted, because the scramble of the image is not released. As a result, shoplifting renders a useless product and thus decreases.

If a password is BCA-recorded permanently in a rental video store or another store, a shoplifted disk can be used. In this case, as shown at Process **6**, the BCA is read by a POS bar code reader in the store. A password for releasing the scramble is issued at Step **951***g*, printed on the receipt at Step **951***i*, and handed to the customer at Step **951***j*. The customer enters, at Step **951***k*, the password on the receipt in a player with numeric keys at his/her house. At Step **951***p*, the disk is replayed for a predetermined number of days. If a user rents a disk, given a password for only part of the software in the disk, and when he/she wants to view other part of the software, he/she can replay it by being informed of the password for this part by telephone at Step **951***u*, and entering the password in Step **951***k*. A rental video store has been shown as an example. When a piece of enciphered software for a personal computer is sold at a personal computer software store, the password may be printed by a POS terminal and handed to the buyer.

The operations of Processes **5** and **6** in FIG. **15** at a selling or rental store will be explained in more detail with reference to FIG. **14**. A selling store receives an enciphered and/or scrambled disk **944***f* from the software maker. After the store confirms its receipt of money from a user, it sends from its bar code recorder **945** the ID number of the disk **944***f* and the data on the sub-public key via its POS terminal **946** to the password issue center **952**. For a small-scale system, the password issue center, that is, the system including the sub-secret key of the sub-public key may exist in the POS terminal. The password issue center inputs the disk ID number and the time data at Step **951***q*, computes them at Step **951***s*, enciphers them with the sub-secret key at Step **951***t*, issues a password at Step **951***g*, and sends it through the network **948** and POS terminal **846** to the BCA bar code recorder **945**. Then the recorded disk **944***g* is handed to the customer. The disk **944***g* can be replayed as it is.

For rental stores and personal computer software stores, ROM disks **944***f* the ciphers and/or scrambles of which have not been released are displayed in stores. If a customer designates a particular ROM disk **944***f*, the bar code of the reflection layer by the non-reflection part **915** of the disk **944***f* is read, so that the disk ID number is read, by a person holding a circular bar code reader **950** with an integrated rotary optical head **953** for spirally scanning, and pressing it on the center of disk **900** in a transparent case. By printing the commodity bar code of the disk ID as shown at **852** in FIG. **13**, it is possible to read the code with an ordinary POS terminal bar code reader. Alternatively, the pressed circular bar code recorded in advance on the original disk may be read. These data including the disk ID are processed by the POS terminal **946**. The charge is settled by credit card. The password issue center issues, at Step **951***g*, a password associated with the ID number as stated above. For rental use, a password is made by enciphering the disk ID number with date data added as used at Step **951***r* in order to limit the number of days for which the disk can be replayed. For this password, the disk can operate on only particular days. It is therefore possible to set a rental period, which may be three days, for instance, in the password.

The thus issued password for descrambling is printed at Step **951***i* together with the date of rent, the date of return and the rental title charge on the receipt **949**, and handed with the disk to the customer. The customer takes the disk **944***j* and receipt **949** home. At step **951***k*, the customer enters the password with the ten-key input part **954** of the first computer **909** in FIG. **6**, so that the password **835** is computed with the ID number **835***a* and input into the cipher decoder **837**. Then, the password is converted into plaintext by means of the decoding key. Only if the password is correct, will the cipher decoder **837** descramble the program data and supply image output.

In this case, if the password includes time data, the data is checked with the date data of the clock part **836***b*. The password is descrambled for the coincident dates. The inputted password is stored together with the associated ID number in the nonvolatile memory **755***a* of the memory **755**.

Once the user enters the password, it is descrambled without being entered again. It is thus possible to lock and unlock the disk electronically in distribution.

With reference to FIG. **16**, the method of decoding the software of a disk which has been recorded as cipher data will be explained in detail.

Step (Process) **865** represents the overall flow of distribution of cipher data and individual IDs to users. First, at Step **865***a*, a number 'm' of data enciphered with the secret first cipher key and a program for decoding the enciphered data are recorded in the ROM area of an original disk. At Step **865***b*, substrates are molded from the original disk, and then the substrates with reflection films added thereto are laminated in pairs to make completed ROM disks. At Step **865***c*, the decoding data (the disk identification data different for the pressed disks, respectively, and/or the decoding key for the cipher data) necessary to decode the enciphered data is recorded in the auxiliary recording area (called BCA), which cannot be rewritten, of each completed disk by a method of modulation different from that for the ROM area. At Step **865***d*, a user replays the distributed disk, selects a desired enciphered data 'n', and starts the decoding process. At Step **865***e*, the user's first computer reproduces the enciphered data and the decoding program from the ROM area, and reads the decoding data from the auxiliary recording area (BCA). If, at Step **865***f*, the second decoding data is not obtained on-line, then, at Step **871***a* of FIG. **17**, the ID and/or other auxiliary decoding data are displayed on the screen. At Step **871***b*, the user obtains the second decoding data such as the password associated with the ID, and enters it into the first computer. Carried out at Step **871***c* is a particular operation of an open-key cipher function with the disk identification data, the second decoding data, and the enciphered data 'n' If, at Step **871***d*, the result is correct, then, at Step **871***f*, the '1- n'th data is translated into plaintext, so that the user can make the software of the data 'n' operate.

Next, with reference to the flowchart of FIG. **18**, the method of cryptocommunication essential to the Internet and/or the like using a BCA will be described. Step (Process) **868** is the routine of the method of distributing the communication program and cipher key for communication to users. First, at Step **868***a*, at least the communication program and/or connection data are recorded in the ROM area of an original disk. At Step **868***b*, substrates are molded from the original disk, and the substrates are laminated in pairs to make completed ROM disks. At Step **868***c*, the disk identification data different for the pressed disks, respectively, and the cipher key for cryptocommunication are recorded in the non-rewritable auxiliary recording area (BCA) of each completed disk. According to circumstances, the connection address of the second computer and/or the decoding key for cryptocommunication is recorded by a method of modulation different from that for the ROM area. At Step **868***d*, the user's first computer reproduces the communication program and the decoding program from the ROM area, and reads the disk identification data and the cipher key for communication from the auxiliary recording area. The process continues at FIG. **19**. At Step **867***a*, it is judged if there is a connection address in the BCA area. If yes, the second computer is accessed, at Step **867***b*, on the basis of the connection address such as the BCA area URL. If there is no connection address, the computer of the connection address in the ROM area is accessed at Step **867***c*. At Step **867***d*, the transmit data is input. At Step **867***e*, it is judged if there is a cipher key for cryptocommunication in the BCA area. If so, the transmit data is enciphered, at step **867***g*, with the cipher key for cryptocommunication in the BCA area to make a third cipher. If not, the data is enciphered, at step **867***f*, with the cipher key for cryptocommunication in the ROM area or HDD to make a third cipher.

In FIG. **20**, Step (Process) **869** represents the routine of generating a decoding key for the cipher received from the second computer **910**. First, at Step **869***a*, the first computer judges if a decoding key for communication is necessary. If necessary, the process goes to Step **869***b*, where a check is made to judge if there is a decoding key for communication in the BCA. If there is no decoding key, the process goes to Step **869***c*, where a pair of second cipher key for communication and second decoding key for communication is generated newly with the program for generating the cipher key/decoding key reproduced from the ROM area, by the user keying or with data from a random number generator and the second encoder reproduced from the ROM area. At Step **869***d*, a fourth cipher is made which is the second cipher key for communication and/or the user data enciphered with the cipher key for communication recorded in the BCA and the encipherment software reproduced from the ROM area. At Step **869***e*, the fourth cipher and the disk identification data and/or the user address are sent to the second computer of the connection address reproduced from the disk. The process of the second computer includes Step **869***f*, where the fourth cipher, the disk identification data and the user address are received. At Step **869***g*, the decoding key for communication paired with the disk identification data is selected from the decoding key data base, and the fourth cipher is decoded with the selected key to obtain the plaintext of the second cipher key for communication. At Step **869***h*, the fifth cipher which is the server data including part of the user data and enciphered with the second cipher key for communication is sent through the Internet **908** to the first computer. At Step **869***i*, the fifth cipher (and disk identification data) is (are) received, and decoded with the second decoding key for communication and the decoding function recorded in the ROM area to obtain the plaintext of the server data. In this way, the method of Step **869** in FIG. **20** realizes two-way cryptocommunication between the first and second computers.

In FIG. **21**, Step (Process) **870** represents the routine of receiving accounting data. If, at Step **870***a*, the accounting data is input, the third cipher key of the public key cipher for accounting communication is requested from the second computer. At Step **870***b*, the second computer requests the third cipher key from the third computer. The third computer **911** sends the ID and third cipher key to the second computer, though the exchange step is omitted. At Step **870***c*, the second computer receives the ID and third cipher key. At Step **870***e*, the seventh cipher which is the third cipher key enciphered with the second cipher key for communication and/or the like is sent to the first computer. The first computer receives the seventh cipher at Step **870***f*. At Step **870***g*, the received seventh cipher is decoded with the second decoding key for communication so as to obtain the third cipher key (public key of public key function). At Step **870***h*, the third cipher key is recorded on the HDD according to circumstances. This is used for the next transmission. At Step **870***i*, it is judged if a credit card number, a password for settlement and/or other secret accounting data are input. At Step **870***j*, the eighth cipher which is the accounting data enciphered with the third cipher key is sent via the second computer to the third computer. At Step **870***k*, the second computer receives the eighth cipher and transfers it again to the third computer. Only the third computer **912**, which is, for example, at a banking institution, has the

decoding key for the third cipher, so that the second computer, which is an electronic store, cannot decode it. At Step **870***m*, the third computer determines from the cipher key data base the third decoding key associated with the third cipher key by using identification data on the disk and/or the like, and decodes the eighth cipher with the third decoding key, which is the secret key of the public key cipher, so as to obtain the plaintext of the accounting data. At Step **870***n*, a check is made to judge from the user's credit data, deposit remains and/or other banking data whether the money can be received. At Step **870***p*, the third computer informs the second computer of the result of the search. The second computer, which is an electronic store, judges at Step **870***q* if the money can be received. If not, the process goes to Step **870***r*, where the article and/or the key for decoding the cipher software is not sent. If the money can be received, for a key provision system as shown in FIG. **16**, the process goes to Step **870***s*, where the cipher software decoding key, that is, the article is sent via Internet **908** to the user's second computer. At Step **870***t*, the first computer receives the cipher software decoding key. At Step **870***u*, the cipher of the '1- n'th enciphered software is released. At Step **870***w*, the plaintext of the software is obtained. In this way, a content key provision system is realized.

The method of Step **870** in FIG. **21** requests the third computer, that is, a banking institution to issue according to the need a public key for the third cipher key, which needs high security for accounting data. It is not necessary to record the public key in the BCA in advance. It is therefore possible to use for the third cipher key a stronger RSA system cipher key of 256 bytes of RSA2048 without consuming the BCA capacity. Further, because there is no need for recording in the BCAs of all disks in advance, the total of the issued third cipher keys decreases, and the computer CPU time taken to compute the third cipher keys decreases. In addition, because the third ciphers do not exist in the BCAs, they are not opened, so that the security is improved. In this case, the role of the BCA is, as shown in FIGS. **19** and **20**, to record the identification data of a secret communication disk by means of the cipher key of the RSA1024 grade. Only one BCA disk realizes cryptocommunication with the second computer, so that the effect is high.

With reference to FIG. **22**, Step (Process) **872** of cryptocommunication in a case where the cipher key and the decoding key both for communication have been recorded in the BCA will be described. At Step **872***g*, the first computer **909** sends to the second computer **910** the ninth cipher which is the user data enciphered with the cipher key for communication reproduced from the BCA, the basic identification data recorded in the ROM area when the original disk was made, and the disk identification data recorded in the BCA area. At Step **872***b*, the second computer receives the ninth cipher, the disk identification data and the basic identification data. At Step **872***c*, the decoding key for communication paired with the disk identification data from the decoding key data base is retrieved, and the ninth cipher is decoded to obtain the plaintext of the user data. At Step **872***e*, the second cipher key associated with the disk identification data is selected from the cipher key data base. In addition, the second computer sends to the first computer the tenth cipher which is the server data enciphered with this second cipher and the third cipher key received from the third computer by the procedure described in FIG. **21** and enciphered with the second cipher. The first computer receives the tenth cipher at Step **872***f*. At Step **872***g*, the received seventh cipher is decoded with the second decoding key for communication recorded in the BCA, to obtain the plaintext of the server data and the third cipher key (public key of the public key function). At Step **872***h*, according to the need, the third cipher key is recorded on the HDD. At Step **872***i*, it is judged if the accounting data is input. If so, the process goes to Step **872***j*, where the eleventh cipher which is the accounting data enciphered with the third cipher key is sent via the second computer to the third computer. At Step **872***m*, the second computer sends the eleventh cipher again to the third computer. At Step **872***m*, the third computer determines from the third cipher key data base, the third cipher key paired with the identification data on the disk and/or the like, and decodes the eleventh cipher to obtain the plaintext of the accounting data. At Step **872***n*, the possibility that the money can be received from the user is checked. At Step **872***p*, the result of the search is sent to the second computer. At Step **872***q*, the second computer checks to judge if the money can be received from the user. If so, for a key provision system as shown in FIG. **16**, the process goes to Step **872***s*, where the cipher software decoding key, that is, an article is sent via the Internet to the user's second computer. At Step **872***t*, the first computer receives the cipher software decoding key. At Step **872***u*, the cipher of the '1- n'th enciphered software is released. At Step **872***w*, the plaintext of the software is obtained. In this way, a content key provision system is realized.

The merit of the effect of the method of Step **872** in FIG. **22** is that, because both the cipher key and the decoding key are recorded in the BCA area, it is not necessary to transmit the decoding key and/or the cipher key necessary for reception from the second computer. The maximum BCA capacity is 188 bytes. A public key and/or another cipher function needs only 128 bytes, and can therefore be recorded. Further, it is possible to bidirectionally encipher the grade in RSA512. Because seven or eight elliptic functions can, as shown in FIG. **7**, be stored, elliptic functions are more effective.

With reference to FIG. **23**, the operation and effect in a case where the first and third cipher keys have been recorded in the BCA in advance will be explained. Because Steps **872***a* through **872***w* in FIG. **22** are nearly identical with Steps **873***a* through **873***w* in FIG. **23**, only the different steps will be explained.

The third cipher key for protecting the security for accounting data and/or other banking data has been recorded in the BCA. Therefore, at Step **873***e*, the second and third computers do not need to generate and send the third cipher key. At Steps **873***e*, **873***f* and **873***g*, the twelfth cipher is sent and received. At Step **873***j*, the third cipher key is read from the BCA area, and the user's accounting data is sent via the second computer to the third computer. The method of FIG. **23** does not need the third cipher key generated, sent and received at all, so that the procedure is simple.

In the case of electronic settlement systems, in general, there are a plurality of accounting centers representative of credit companies. Therefore, naturally, there is a need for a plurality of third cipher keys, which are public keys. As explained with reference to FIG. **7***b*, there is a need for an RSA1024 grade or more, that is, 128 bytes or more if an RSA cipher function is used. The third cipher key **817***b* can therefore enter only one place of 188 bytes of the BCA. However, elliptic-function cipher keys (elliptic ciphers) which have appeared in recent years give, with small capacity, security equivalent to that of RSA. In recent years, RSA function RSA1024 has been the lowest standard of banking data security. While an RSA function needs 128 bytes, it is said that an elliptic cipher needs only about 20 through 22 bytes for equivalent security. Therefore, as

shown in FIG. 7*c*, it is possible to store in the BCA seven, eight or fewer third ciphers which deal with banking data. The use of elliptic functions realizes a BCA-application electronic settlement system which can deal with a plurality of essential banking centers. Explanation has been made, concentrated on the third cipher, but even if an elliptic cipher is used for the public key for the first cipher key, its effect is similar because high security is kept in relation to a plurality of electronic stores.

With reference to FIG. **24**, the RAM disk recorder/reproducer with a BCA explained with reference to FIG. **10** will be described in more detail. As an embodiment, the procedure for recording in a RAM disk in a so-called pay-per-view system will be described. First, with its program transmitter **883**, a CATV company or another software company enciphers movie software or other contents **880** by using the first cipher key **882** in the first encoder to generate a first cipher **900**, and sends this cipher to a decoder **886** such as each user's CATV decoder. If the decoder **886** sends a request for a particular program through a network in a key issue center **884**, the center sends the first decoding data **885***a* to the first decoding part **887** of the first decoder **886**. The first decoding data **885***a* is a particular piece of software such as the scramble release key for the particular decoder system ID number and particular timing data **903**, and includes a recording permission card **901** for a RAM disk. The first decoding part **887** decodes the first cipher **900** with the system ID **888** and first decoding data **885***a*. In the case of a picture signal, the signal descrambled once and scrambled further with another cipher to protect the signal from being copied is output from the third cipher output part **889**. The picture can be viewed and listened to on a general TV **899**, though the original signal is guarded from being copies. If the recording permission code **901***a* is NO, it is not possible to record in a RAM disk **894**. If OK, however, it is possible to record in only one RAM disk **894**. This method will be explained.

In the decoder **886**, an IC card **902** is inserted, and the BCA reproduction part **895** reads the BCA of the RAM disk **894** in a RAM recorder. Then the disk ID **905** is sent to the IC card **902**. The IC card **902** checks the recording permission code **901***a* and the present time data **904** obtained from the disk IC **905** and the decoder **886**, and makes a two-way hand-shake type copy check **907** with the third cipher output part **889**. If the recording permission code and copy checks are OK, the second auxiliary encoder **891** in the IC card **902** issues a second cipher key **906**. The second encoder **890** enciphers the third cipher again to generate a second cipher, which is the contents **880** enciphered with the disk ID of a particular disk. The second cipher is sent to the RAM recorder **892**, where it is 8–15 or 8–16 modulated by the first modulation part in the recording means **893**. The second cipher **912** is recorded in the first recording area **894***a* of the RAM disk **894** by means of a laser. In this way, the data of the RAM disk **894** is enciphered with the particular disk ID number.

When the reproduction signals in this disk are 8–16 demodulated by the first modulation **896***a* using a normal reproduction means **896**, the second cipher of the contents is output. The second decoder **897** has second decoding keys **898***a*, **898***b* and **898***c*, which correspond to the cipher keys of the IC cards different for CATV stations or other program supply companies, respectively. In this case, the decoding key identification data of the decoder **868** or IC card **886** has been recorded in the first recording area **894***a*. The reproducer reads the decoding key identification data **913** from the first recording area **894***a*. The decoding key selection means **914** automatically selects out of the decoding keys **898***a* through **898***z* the second decoding key **898***a* corresponding to each cipher key. With the disk ID **905***a* as a key, the second decoder **897** decodes the second cipher. An IC card having a particular decoding key might be used. In the case of an image, it is possible to obtain a normal image descrambled at a TV **899***a*.

In the system of FIG. **24**, a disk ID **905** is sent to the IC card inserted into the decoder in each user's home to encipher picture image data and/or the like. It is therefore not necessary for the software company **883** to individually change the cipher of the contents for distribution to users. Consequently, when broadcasting scrambled pay-per-view images to a great number of viewers as is the case with satellite broadcasting and CATV, it is possible to permit recording in only one RAM disk per user.

If, at the same time when recording is made in a disk in the system of FIG. **24**, an attempt is made to illegally copy, that is, record in a second disk, that is, a RAM disk of another disk ID, it is not possible to alter the disk ID because two-layer disks are used for BCAs. Therefore, unauthorized copying in the second disk at the same time is prevented. It can be considered that during another time period, a simulated or dummy recording permission code **901***a* and/or a third cipher is sent to the decoder and/or IC card and data is recorded in a RAM disk of another disk ID. Even against such unauthorized practice, the decoder time data control part **902** in the IC card compares the time of the timing data **903** of the key issue center **884** and/or the time of the time data of the contents and the present time of the time data part **904***a* in the decoder to judge if they coincide. If so (OK), the IC card **902** permits the encipherment of the second cipher computing unit **990**.

In this case, a hand-shake type time check method might be used which makes the second encoder **890** and first decoder **887** exchange check data bidirectionally.

In the case of the hand-shake type, the second cipher computing unit **890** including the IC card, the first decoding part **887**, and the third cipher part **889** confirm the cipher data bidirectionally. This prevents the unauthorized copying during the other time periods outside the time when the contents are sent.

In this way, in each user's decoder **886**, the software company's contents are recorded in only one RAM disk **894** for each particular disk ID. This disk can be reproduced by any RAM disk reproducer. Even in the case of recording in a RAM disk by the method of FIG. **24**, the software company's copyright is protected. Althoughthe encipherment and decoding have been explained with reference to the cipher encoders and cipher decoders, respectively, in the detailed description of the drawings, the cipher algorithm and the decoding algorithm are practically used with programs in a CPU.

INDUSTRIAL APPLICABILITY

By thus recording in advance the cipher key and/or the decoding key for an ID and/or a cipher in the BCA area of an optical disk, it is possible to release the cipher of enciphered contents by a simpler procedure. In addition, the secrecy of communication is realized without a conventional procedure for registration. By storing a network check program in contents, it is possible to prevent pieces of software of the same ID on the same network being installed. Thus, there are various effects on the improvement of security.

REFERENCE MATERIALS	
801:	disk with a BCA
802:	fixed key
803:	cipher encoder or scrambler
804:	recording means
805:	contents
806:	ID
807:	trimming unit
808a:	molding machine
808b:	reflecting film making machine
808c:	bonding machine
809:	completed disk
809a:	single-sided disk
809b:	single-sided disk
811:	press field
813:	fixed key
814:	BCA area
815:	disk ID
816:	first cipher key (secret key)
817:	second cipher key (secret key)
818:	connection address
819:	reproducing unit
820:	BCA reproducing section
821:	password issue center
822:	communication section
823:	network
824:	cipher key DB
825:	first decoding key
826:	contents number
827:	first cipher decoder
828:	accounting center
829:	second decoding key
830:	accounting data
831:	second cipher encoder
832:	second cipher decoder
833:	timing data
834:	password producing section
835:	password
836:	personal computer
837:	third decoding key
838:	common key
839:	third cipher key
840:	third cipher encoder
841:	third cipher decoder
842:	main cipher encoder
843:	main cipher decoder
844:	main decoding key
845:	first cipher decoder
846:	cipher encoder
847:	cipher decoder
849:	BCA data
850:	writing layer
851:	character
852:	general bar code
853:	decoder
860:	second cipher encoder
861:	second cipher decoder
862:	data reproducing section
863:	ROM area
864:	additional recording area
865:	decoding flowchart
890:	second cipher computing unit
894a:	first recording area
908:	Internet
909:	first computer
910:	second computer
911:	third computer
912:	second cipher
913:	decoding key identifying data
914:	decoding key selecting means

-continued

REFERENCE MATERIALS	
915:	first slice level
916:	second slice level
917:	PE-RZ modulator
918:	transparent substrate
919:	first recording area
920:	second recording area
921:	disk ID
922:	BCA flag
923:	CPU
924:	control data
925:	EFM demodulation
926:	8–15 modulation-demodulation
927:	8–16 modulation-demodulation
928:	first demodulating section
930:	second demodulating section
931:	connection address

What is claimed is:

1. An information recording device for recording information on an optical disk comprising a first recording area and a second recording area, said device comprising:

means for recording information using a first modulation method into a first recording area of such an optical disk;

means for reading disk identification information recorded by a second modulation method in a second recording area of such an optical disk;

means for encrypting information using a cipher key and any one such optical disk's unique identification information, into encrypted information unique to that one optical disk; and

wherein said means for recording is capable of recording encrypted information unique to an optical disk in said first recording area of said optical disk.

2. The information recording device of claim **1**, wherein said means for recording information uses 8–16 modulation as said first modulation means.

3. The information recording device of claim **1**, wherein the means for reading disk identification information includes means for demodulating information modulated using phase method encoded (PE) modulation as said second modulation method.

4. The information recording device of claim **1**, wherein said recording means records information using 8–16 modulation as said first modulation method, and said reading means demodulates information modulated using phase encoded (PE) modulation as said second modulation method.

5. The information recording device of claim **1**, wherein said disk identification information recorded in said recording area of an optical disk comprises circumferentially arranged multiple stripe patterns each stripe of which extends along a radius of the disk.

* * * * *